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ABSTRACT

A residential instructional program was developed which provided two 2-week institutes for handicapped students during the summer of 1982. Recognizing that most of these students are mainstreamed and do not take science laboratory courses, the program focused heavily on the outdoor laboratory setting at an environmental center. In addition, mindful of the attitudinal, informational, and communicative barriers experiences by these youngsters, a curriculum was chosen which minimized these barriers as much as could be practicable. The program was designed to give students optimal exposure to concrete examples of theory while minimizing the amount of time spent in lecture and textbook study. This document discusses: (1) program philosophy/objectives, participant selection, and instructional staff/counselor training; (2) the curriculum and specialized adaptations; (3) the recreational program; (4) evaluation (including pre-/post-test and student/staff evaluation); (5) assessment of outcomes; and (6) dissemination efforts. Provided in the curriculum section are lecture/film outlines, abstracts of environmental/ecological activities used, with complete copies of selected activities (including grade level(s), goals, concepts/skills fostered, behavioral objectives, background information, and instructional strategies). Supporting documentation (including pre/post tests, staff evaluation forms, and handouts distributed at inservice workshops) is included in appendixes. Evaluation results indicate that the program was successful in meeting its objectives. (JN)

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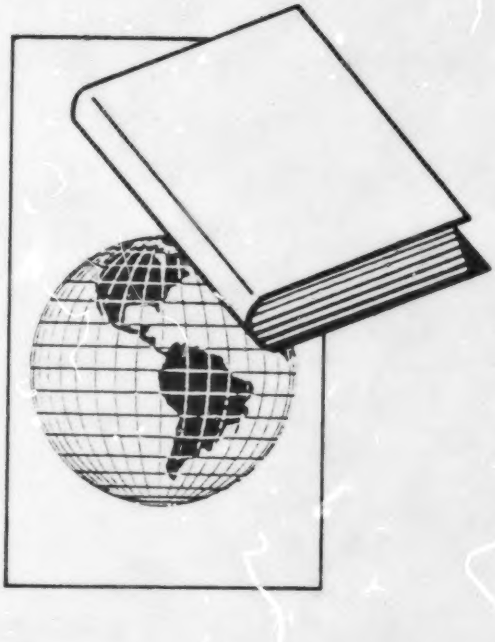

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SIU Southern Illinois University
at Carbondale

Final Report
to the
National Science Foundation

Field Application of Ecological Principles for Physically Handicapped High School Students

Conducted at
Touch of Nature Environmental Center
Southern Illinois University at Carbondale
Carbondale, Illinois

Project Co-Directors

Dr. Bruce Petersen
Dr. Mary Jane Sullivan

Acknowledgements

The co-directors wish to acknowledge the excellent cooperation which they received from both the Touch of Nature Environmental Workshop staff and the counselor-aides throughout the course of the four-week field activities. In addition, they would like to thank Ruth Alliband and her staff for their secretarial support and James Lipe and his staff, and Ray Graesser and his staff without whom our stay at the Environmental Center would not have been as pleasant.

We would also like to acknowledge the cooperation which we received from the SIUC Pollution Control Center. Dr. John Meister graciously opened the center to our students for a presentation by SIUC students working in the center, Jim Muller, Chris Jensen, Janet Kronwell and Karen Lyman.

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I. INTRODUCTION

A. Philosophy and Objectives of Program

The purpose of this project, "Field Application of Ecological Principles for Physically Handicapped High School Students," was to provide two two-week institutes for handicapped high school students during the summer of 1982.

Recognizing the fact that most students with low-incidence handicapping conditions are mainstreamed into regular classrooms and that most of these students do not take science lab courses, the project directors designed a science program which focused heavily upon the outdoor laboratory.

Mindful of the attitudinal, informational, environmental and communicative barriers experienced by handicapped youngsters, a curriculum was chosen which would minimize these barriers as much as could be practicable. The program was designed to give students optimal exposure to concrete examples of theory while minimizing the amount of time spent in lecture and with a textbook.

There were five major goals of the academic curriculum.

Goal 1 - To introduce handicapped high school students to the ecological concepts associated with limnology and terrestrial biology.

Goal 2 - To give handicapped students an opportunity to apply these concepts in direct laboratory and field experiences.

Goal 3 - To develop self confidence in these students in the area of experimental science.

Goal 4 - To develop a sensitivity on the part of these students to the societal impact and value issues related to environmental planning.

Goal 5 - To serve as a model to regional school systems for methods of adapting science curriculum to the special needs of the handicapped.

The Touch of Nature Environmental Center served as the site for the residential instructional program. This facility was an excellent base for this program. (See Appendix I) For many years the Center has maintained programs in environmental education for advanced high school students and recreational programs for the handicapped. The project sponsored by the National Science Foundation was the first time that the two activities were united in a carefully developed program.

To achieve the five major goals of the project a plan of work with appropriate activities was outlined and refined. The committee which developed this curriculum was composed of Dr. Bruce Petersen, Gerald Culen, George Davis, and Dr. Mary Jane Sullivan. The work plan or schedule of activities was developed around the following ecological principles.

A. Individuals and populations

B. Interactions and interdependence

C. Environmental influences and limiting factors

D. Energy flow and materials cycling (biogeochemical cycling)

E. The community and ecosystem concepts

F. Homeostasis

G. Succession

H. Man as an ecosystem component

I. The ecological implications of man's activities and his communities

B. Participants

Recruitment of Students

Upon receiving word of the receipt of the grant from the National Science Foundation, the project co-directors forwarded a letter to selected agencies for the handicapped in the state notifying them of the program and requesting assistance in recruiting students. Copies of this letter, other recruitment correspondence and the printed brochure for the program may be found in Appendix. The only response to this initial request came from the office of the Superintendent of the Illinois School for the Visually Handicapped who recommended that we send the information to the following schools:

Mr. Durward A. Hutchinson, Supt.
Indiana School for the Blind
7725 College Avenue
Indianapolis, Indiana 46240

Mr. Gilbert Bliton
Educational Consultant
Division of Special Education
Indiana State Department of
Public Instruction
229 State House
Indianapolis, Indiana 46204

Miss Gloria Calovini, Director
Educational Media and
Information Services
Illinois State Board of Education
100 North First Street
Springfield, Illinois 62777

Dr. Richard M. DeMott, Supt.
Iowa Braille & Sight Saving School
1002 G Avenue
Vinton, Iowa 52309

Mr. John N. Taylor, Director
Iowa Commission for the Blind
4th and Keosauqua
Des Moines, Iowa 50309

Ms. Gail Sullivan Fleig
Special Education Media
Specialist
Iowa Dept. of Public Instruction
Grimes State Office Building
Des Moines, Iowa 50319

Dr. Hugh A. Pace, Superintendent
Kansas State School for the
Visually Handicapped
1100 State Avenue
Kansas City, Kansas 66102

Mr. Harold L. Hodges
Education Program Specialist
Kansas State Department of
Education
120 East Tenth Street
Topeka, Kansas 66612

Mr. Will D. Evans, Supt.
Kentucky School for the Blind
1867 Frankfort Avenue
Louisville, Kentucky 40206

Mrs. Julia French, Director
Div. of Physically Handicapped
Bureau of Education of
Exceptional Children
Kentucky Department of Education
815 Capital Plaza Tower
Frankfort, Kentucky 40601

Dr. Nancy J. Bryant, Supt.
Michigan School for the Blind
715 West Willow Street
Lansing, Michigan 48906

Mrs. Julie A. Nicol
Media Center for the
Visually Impaired
Michigan Department of Education
Pine at Maple
Lansing, Michigan 48913

Mr. Carl T. Johnson
Residential School Administrator
Minnesota Braille & Sight
Saving School
P. O. Box 68
Faribault, Minnesota 55021

Miss Marilyn Sorenson, Consultant
Vision & Physically Handicapped
Div. of Special & Compensatory Ed.
Minnesota State Department of Ed.
Capitol Square Building
550 Cedar Street
St. Paul, Minnesota 55101

Mr. Louis M. Tutt, Supt.
Missouri School for the Blind
3815 Magnolia Avenue
St. Louis, Missouri 63110

Mr. Jerry L. Regler, Supt.
Nebraska School for the Visually
Handicapped
P.O. Box 129
Nebraska City, Nebraska 63410

Mr. Don J. Pickering
Director of Education
Nebraska School for the Visually
Handicapped
Nebraska State Dept. of Education
P.O. Box 129
Nebraska City, Nebraska 68410

Mr. Dennis L Holmes, Supt.
Ohio State School for the Blind
5220 North High Street
Columbus, Ohio 43214

Dr. John Saylor Ed. Consultant
c/o Juie Todd, Director
Resource Center for the Visually
Handicapped
470 East Glenmont Avenue
Columbus, Ohio 43214

Mr. Charles B. Boyer, Supt.
South Dakota School for the
Visually Handicapped
423 - 17th Avenue, S.E.
Aberdeen, South Dakota 57401

Mr. A. Jack Rumbaugh, Supt.
Tennessee School for the Blind
115 Stewarts Ferry Pike
Nashville, Tennessee 37214

Ms. Wanda Moody
Assistant Commissioner
State Department of Education
Division for the Education of
the Handicapped
103 Cordell Hull Building
Nashville, Tennessee 37214

Mr. William H. English, Supt.
Wisconsin School for the
Visually Handicapped
1700 West State Street
Janesville, Wisconsin 53545

Mr. Andrew S. Papineau, Supervisor
of Schools for the Visually
Impaired
Wisconsin State Department of
Public Instruction
Division for Handicapped
Children
125 South Webster Street
Madison, Wisconsin 53702

November 1981 - December 1981

The brochure which was mailed in November 1981 was, indeed, sent to these individuals as well as to all the Special Education teachers in the state of Illinois through a list provided by the Illinois Office of Education. In addition, the 100 directors of the Special Education Districts in the state of Illinois were sent a copy of this brochure for distribution of the information within their regions.

A particularly strong effort was made at this time to reach hard-of-hearing students. A letter of invitation and five copies of the brochure were sent in November to over 63 midwestern schools and programs for the hearing impaired.

The following states neighboring Illinois were targeted for particular emphasis in recruitment: Arkansas, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Ohio, Pennsylvania, Virginia, and Wisconsin. Over 115 schools and school systems with specialized programs for the handicapped were sent this brochure.

Three hundred Special Education teachers within the counties of Kentucky, Indiana, and Missouri which are contiguous to Southern Illinois also received the brochure in November.

In December, a letter and 10 descriptive brochures requesting assistance in passing the word was sent to the following organizations serving the handicapped:

National Epilepsy Foundation
A. G. Bell Association for the Deaf
American Council for the Blind
Disabled in Action
National Association of the Deaf

National Association of the Deaf/Blind of America

National Association of the Physically Handicapped, Inc.

National Congress of Oranizations of the Physically, Inc.

National Federation of the Blind

National Multiple Sclerosis Society

National Paraplegia Foundation

United Cerebral Palsy Association

United Ostomy Association

A copy of this letter--stressing no charge to students--appears in the appendix of this report.

January - March 1982

From January to mid-March 1982 an intensive effort was made to reach those students who might not have daily contact with the special education network. A news release was sent to all Illinois newspapers at this time.

In early spring a copy of the brochure and a letter requesting that they print information about the program and the fact that it was at no charge to students in their newsletter was sent to the following organizations:

CEREBRAL PALSY

United Cerebral Palsy Association
66 East 34th Street, 3rd Floor
New York, New York 10016

EPILEPSY

Epilepsy Foundation of America
1828 L Street, N.W., Suite 406
Washington, D.C. 20036

HEALTH IMPAIRMENTS

American Diabetes Association
600 Fifth Avenue
New York, New York 10020

American Heart Association
7320 Greenville Avenue
Dallas, Texas 75231

American Lung Association
1740 Broadway
New York, New York 10019

Asthma and Allergy Foundation
of America
19 West 44th Street, Suite 702
New York, New York 10036

The Candlelighters Foundation
2025 Eye Street
Washington, D.C. 20003

Cystic Fibrosis Foundation
Suite 309
6000 Executive Boulevard
Rockville, Maryland 20852

Juvenile Diabetes Foundation
23 East 26th Street, 4th Floor
New York, New York 10010

Leukemia Society of America
800 Second Avenue
New York, New York 10017

National Association for Sickle
Cell Disease, Inc.
3460 Wilshire, Suite 1012
Los Angeles, California 90010

National Hemophilia Foundation
19 West 34th Street
Room 1204
New York, New York 10001

National Kidney Foundation
Two Park Avenue
New York, New York 10016

National Neurofibromatosis Foundation
340 East 80th Street, #21-H
New York, New York 10021

National Tay-Sachs Foundation and
Allied Diseases Association
122 East 42nd Street
New York, New York 10017

National Tuberous Sclerosis
Association, Inc.
P.O. Box 159
Laguna Beach, California 92652

United Ostomy Association
2001 W. Beverly Boulevard
Los Angeles, California 90057

HEARING IMPAIRED

Alexander Graham Bell Association
for the Deaf
3417 Volta Place, N.W.
Washington, D.C. 20007

National Association of the Deaf
814 Thayer Avenue
Silver Spring, Maryland 20910

PHYSICALLY HANDICAPPED

American Brittle Bone Society
Cherry Hill Plaza Suite LL-3
1415 East Marlton Pike
Cherry Hill, New Jersey 08034

Arthritis Foundation
3400 Peachtree Road, N.E.
Suite 1106
Atlanta, Georgia 30326

Human Growth Foundation
4930 West 77th Street
Ninneapolis, Minnesota 55435

Little People of America
P.O. Box 126
Owatonna, Minnesota 55060

Muscular Dystrophy Association, Inc.
810 Seventh Avenue
New York, New York 10019

National Amputation Foundation
12-45 150th Street
Whitestone, New York, 11357

National Association of the
Physically Handicapped, Inc.
76 Elm Street
London, Ohio 43140

National Multiple Sclerosis
Society
205 East 42nd Street
New York, New York 10017

National Spinal Cord Injury
Foundation
369 Elliot Street
Newton Upper Falls, Mass. 02164

Osteogenesis Imperfecta
Foundation
632 Center Street
Van Wert, Ohio 45891

Spina Bifida Association
of America
343 South Dearborn Street
Room 319
Chicago, Illinois 60604

Tourette Syndrome Association
40-08 Corporal Kennedy Street
Bayside, New York 11361

SPEECH IMPAIRMENTS

American Speech - Language -
Hearing Association
10801 Rockville Pike
Rockville, Maryland 20852

VISUAL IMPAIRMENTS

American Council of the Blind
1211 Connecticut Avenue, N.W.
Suite 506
Washington, D.C. 20036

American Council of the Blind
Parents
Rt. A Box 78
Franklin, Louisiana 70538

American Foundation for the
Blind
15 West 16th Street
New York, New York 10011

International Institute for
Visually Impaired 0-7, Inc.
1975 Rutgers Circle
East Lansing, Michigan 48823

National Association for Parents
of Visually Impaired
2011 Hardy Circle
Austin, Texas 78757

National Association for
Visually Handicapped
305 East 24th Street
New York, New York 10010

National Federation of the Blind
1800 Johnson Street
Baltimore, Maryland 21230

ALL DISABILITIES

American Coalition for Citizens
with Disabilities
1200 15th Street, N.E.
Suite 201
Washington, D.C. 20005

The Association for the Severely
Handicapped
7010 Roosevelt Way, N.E.
Seattle, Washington 98115

March of Dimes Birth Defect
Foundation
1275 Mamaroneck Avenue
White Plains, New York 10605

National Easter Seal Society
for Crippled Children and
Adults
2023 W. Ogden Avenue
Chicago, Illinois 60612

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The project directors made on site visits to large metropolitan areas to bring news of the program to interested personnel who would pass it on to concerned students and parents.

Including: Minnesota School for the Deaf
- Minnesota School for the Blind
- Minnesota Office of Education
- Meeting of Supervisors of Minnesota Teachers of the Deaf
- Marshall High School for the Orthopedically Handicapped, Minneapolis
- Iowa School for the Deaf
- Nebraska School for the Deaf
- Omaha Public Schools
- Kansas School for the Deaf
- Indiana State Office of Education, Special Education Division
- Indiana School for the Deaf
- Kentucky State Office of Education, Special Education Division
- Kentucky School for the Blind
- Memphis, Tennessee Board of Education, Special Education Division
- Chicago, Illinois Board of Education, Special Education Division
- St. Louis, Missouri Superintendent of Schools
- Spalding High School, Chicago, Illinois
- Whitney Young High School, Chicago, Illinois
- Central Institute for the Deaf, St. Louis, Missouri

April - May 1982

In mid spring a follow-up mailing was sent to all Special Education districts. Bulk mailings of the flyer were sent throughout Illinois and to the targeted schools for the handicapped. Hundreds of telephone calls were made to principals, supervisors, and teachers during this period. Follow-up news releases were sent to major metropolitan areas.

Final Enrollment of Students

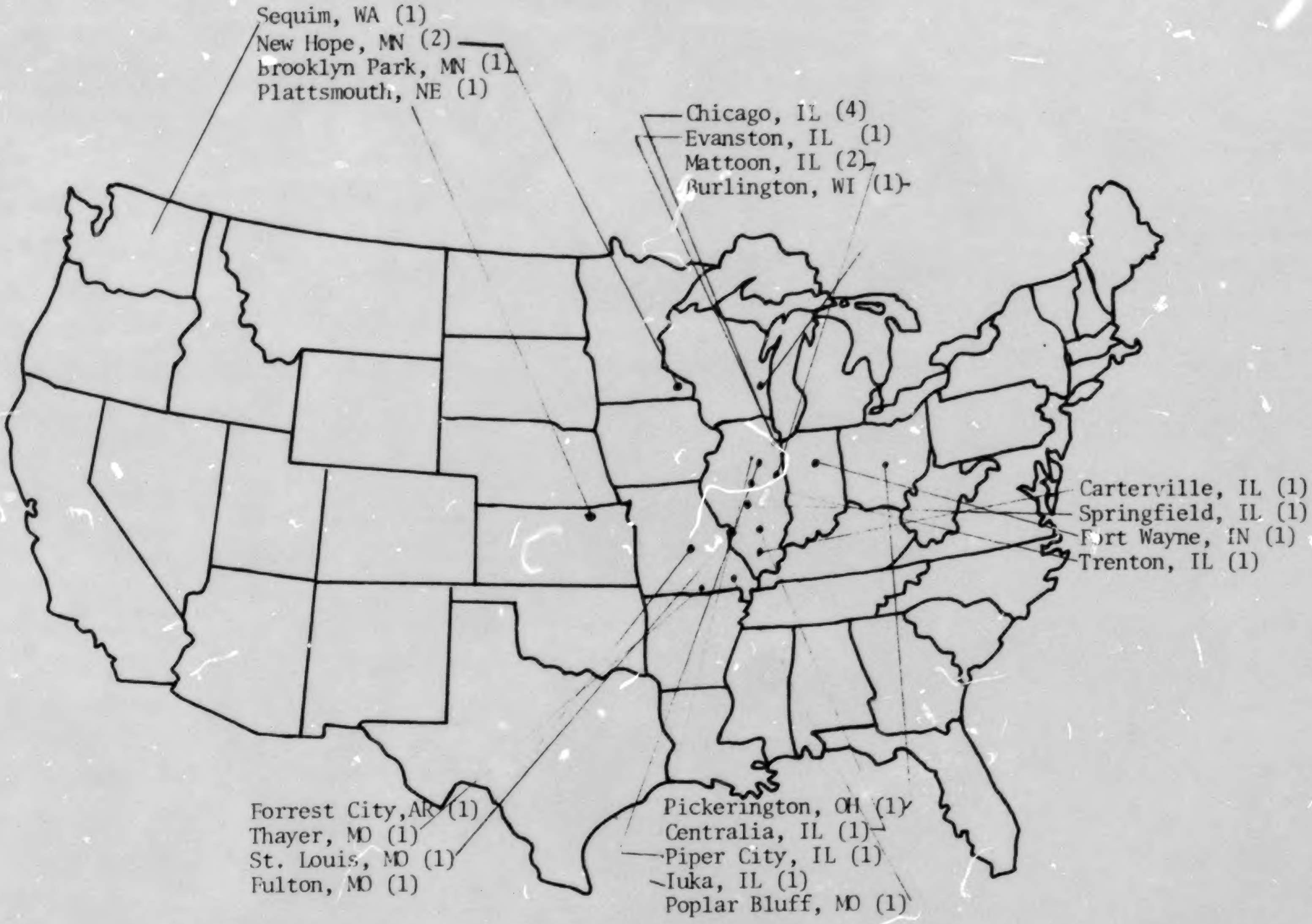
A total of 32 students registered for the program and 26 actually attended the two sessions combined. Six applicants did not attend, two for medical reasons and two for personal reasons and two for unkown reasons.

The expenditure in energies to recruit students was very large. In one case a teacher in a Chicago high school said she personally called twelve parents - and even the suggestion that transportation would be provided was not sufficient to reduce their "overprotectiveness." Another parent also echoed the "overprotectiveness" problem as a major hindrance to participation. However, the project directors consider that another factor in the low response to the program is the rising cost of travel. When it was brought to the attention of the directors by the principle of a school that this indeed was a factor, interested students were made aware of the "transportation" scholarship possibility. However, it is difficult to assess how many students did not apply because of the difficulty in reaching Carbondale easily.

A third reason for the failure to recruit a larger complement of students was the great difficulty in bringing the opportunity to the attention of eligible students and their parents.

Many special education teachers and supervisors failed to distribute their brochures. Many who distributed the brochures did not stress the value of the opportunity or differentiate it from the many church, school, scout and charity camps that are regularly available to these youngsters. One science teacher at a school for the deaf told Dr. Petersen she had no students who would be interested in the program.

The students who attended the program represented a range of handicapping conditions including: hard-of - hearing, legally blind, heart disease, cerebral palsy, epilepsy, and two or three with bone diseases. The degree of physical dependence upon the counselors shown by participants also ranged from complete independence to the need to be fed, dressed, bathed and toileted. Certain students displayed a deep carving for extra attention - with a wide range of emotional dependence absorved among them.


Sequim, WA (1)
New Hope, MN (2)
Brooklyn Park, MN (1)
Plattsmouth, NE (1)
Chicago, IL (4)
Evanston, IL (1)
Mattoon, IL (2)
Burlington, WI (1)
Carterville, IL (1)
Springfield, IL (1)
Fort Wayne, IN (1)
Trenton, IL (1)
Forrest City, AR (1)
Thayer, MO (1)
St. Louis, MO (1)
Fulton, MO (1)
Pickerington, OH (1)
Centralia, IL (1)
Piper City, IL (1)
Iuka, IL (1)
Poplar Bluff, MO (1)

HOME TOWNS OF STUDENTS PARTICIPATING IN SUMMER INSTITUTE

C. Instructional Staff and Counselors

Staff of the Institute

Dr. Bruce Petersen - Project Co-Director, Ph. D., University of Colorado, Boulder, (Animal Ecology), has taught at Southern Illinois University at Carbondale since 1968. During this time he has developed a wide range of innovative science courses including Introductory Environmental Biology, The 'Survival of Man' course, and a travel-study program which explores the ecology of southwestern United States. Petersen has been chairman of Region 8, Illinois Junior Academy of Science. His responsibilities for the project included overall academic planning.

Dr. Mary Jane Sullivan - Project Co.-Director, Ed. D., Ball State University, Muncie, Indiana, Coordinator Individualized Learning, Southern Illinois University at Carbondale, has five years experience of credit and non-credit programs in Higher Education Administration. Her responsibilities include overall administration and coordination of the non-instructional aspects of the program including the budget.

Dr. Paul Yambert, Ph. D., University of Michigan (Natural Resources) was formerly director of Outdoor Laboratories at SIUC. He is presently professor of Forestry at the University and has particular interests in the outdoor biology instruction of handicapped students. Dr. Yambert delivered a two-hour slide presentation to the students with special emphasis upon energy conservation techniques.

Gerald Culen, B.S., Southern Illinois University at Carbondale, (Zoology), is Director of the Environmental Workshops Program at Touch of Nature. A member of the Conservation Education Association and the Illinois Environmental Association, he taught junior high school science in Oak Forest, Illinois. He developed most of the field activities used in the Institute.

Instructional Staff

Mari Guido- Senior in Horticultural Science at Southern Illinois University at Carbondale. Mari led the students in the first session in two outdoor environmental games which concretely explained the concepts conveyed in the lectures.

Paul J. Harmon, M.S. in Botany, Southern Illinois University at Carbondale, has worked with mentally handicapped youngsters in scouting camps and is associated with the Environmental Workshops staff at Touch of Nature. During the project he led the students in a variety of outdoor activities, contributing to the rotting log analysis, interpretive walks, lake seining and the owl-call hayride (a huge success).

James Jordan, M.S. candidate at Southern Illinois Universtiy at Carbondale in Environmental Education, B.S., State University at Brookport New York, has been a full time instructor at Touch of Nature Environmental Workshop Program since 1979. During the project he led the pontoon boat activity, the succession trail, and the quadrat study activities. He explained the concepts in the nature center to the second session of students. His previous experience with handicapped groups consisted of a day-long activities for special populations at the Center.

Michael Skinner, Master's candidate in Biology at Southern Illinois University at Carbondale, B.A. in Biology from SIU-C. A member of the Environmental Workshops staff at Touch of Nature, Michael directed the students in a variety of outdoor activities including flora and fauna identification at Fern Clyffe State Park, ecology games, taxidermy demonstrations and the owl calling experiment. He spent many hours with the youngsters lending his voice and guitar to their social hours.

Jean Wandel, MAT candidate in Biology, Southeast Missouri State University, is an MAT candidate in Deaf Education at Southeast Missouri State University. She participated in the 1981 NSF Marine Science Program for Handicapped students at Wallops Island as a teacher and signer for the deaf. During this project she participated in the same capacity as well as acting as a lifeguard for swimming activities and assisted with the development of instructional reviews.

Staff Aides and Resident Counselors

Donna Adams, B.S. in Deaf Education from MacMurray College, will enter the field of education after student teaching this fall. She served as a resident counselor to students, particularly sharing the communication efforts for deaf students with Jean Wandel.

Mary Bell, B.A., University of Puget Sound, Elementary School teacher for the past 20 years, teaches second grade and is active in the Seattle club for epilepsy. Mary served as an aide and counselor for the girls.

Don Dailey is a member of the Spectrum staff at Touch of Nature. Don spent two weeks with the Summer Institute working as a resident counselor, assisting in dressing and caring for male students and conducted voluntary religious services on Sundays.

Greg Daniels is majoring in University Studies at Southern Illinois University at Carbondale. His previous experience at the Touch of Nature Center includes one year in the Underway program as staff member and three months with the Environmental Workshops program. He worked on the teams obstacle course for special handicapped populations before joining the summer institute as a resident counselor.

John Fitzmaurice is a sophomore in General Studies at Southern Illinois University at Carbondale. This was John's first experience as a resident counselor at a summer camp. He participated in bathing, feeding and dressing youngsters unable to care for themselves.

Deb Harman - B.A. in Elementary Education, Shippensburg State College, Shippensburg, Pennsylvania, has been in retail management for nine years. She works as a volunteer in a diagnostic facility for handicapped children with 1-3 year olds and is enrolled in a master's program in special education.

Courtney Mote, B.S. in Zoology, Southern Illinois University at

Carbondale, previously worked as a camp counselor in regular population. She was a resident counselor for the girls, and lent her knowledge of the field of science to their study time.

George Sullivan, Carbondale, is a freshman at John A. Logan College, Carterville, Illinois. George previously worked at Touch of Nature as a resident counselor in the handicapped recreational programs. He cared for the physical needs of the youngster, particularly with lifting the non-ambulatory students during each session of the Institute.

D. Staff Training

As described in the capsule protraits, the staff chosen for implementation of the program were selected on the basis of attitude towards the handicapped, specialized experience appropriate to their duties and general physical fitness for the demands of the duties. While there was a need for the stabilizing influence of more mature individuals, the verve and energy of the younger counselor was needed also to meet the 24 hour schedule. Most of those selected had little or no previous work with the handicapped. Therefore, it was determined to spend three days on orientation to the program.

The in-service training took place prior to the start of the first of the two-week sessions and included the counselor-aides, instructors and project directors. This training was at the Touch of Nature Environmental Center. The schedule of activities included familiarization with the Center itself, the outlines of the program, first aid and generally becoming personally acquainted with one another.

The schedule of training consisted of:

June 2 - Overview of project objectives - B. Petersen

Responsibilities:

Activities of staff members- Mary Jane Sullivan

Days off schedule - Bruce Petersen

- Introduction to sign language - Jean Wandel
- Practice in use of sign Language - Jean Wandel

June 3 - Description of handicapping conditions of participants - question and answers - Mary Jane Sullivan

Tour of camp ground -- rooms, lake, classrooms - G. Culen

- Practice in care of non-ambulatory campers, practice in communicationg eith non-verbal campers (George Davis, Director, Programs for Special Populations)

June 4 - Full day of first aid training for potential accidents while camp - theory in morning and practicum in afternoon, directed by Emergency Medical Training Supervisor, Robert Marsh.

The morning of June 2nd consisted of familiarization with the program and each individual's responsibilities; however, this overview did not fully prepare the counselors for the full range of responsibilities they would face, nor teach instructors who had never worked with the handicapped what they would have learned from their first week's experience.

During that first session the sign interpreter introduced all the staff to a sign language vocabulary. The afternoon of the first in-service day was devoted to practice by all in the use of signing. This learning session placed all on an equal footing and served to assist the development of group rapport.

The second day of the training session began with an overview of the handicapping condition of the youngsters. By a favorable fluke, the more physically demanding youngster generally chose to attend the second session and by the time that group arrived the staff was more fully prepared to meet the greater range of needs those youngsters represented. However, there were many questions raised in this training as to the level of comprehension of the youngsters of differing disabilities.

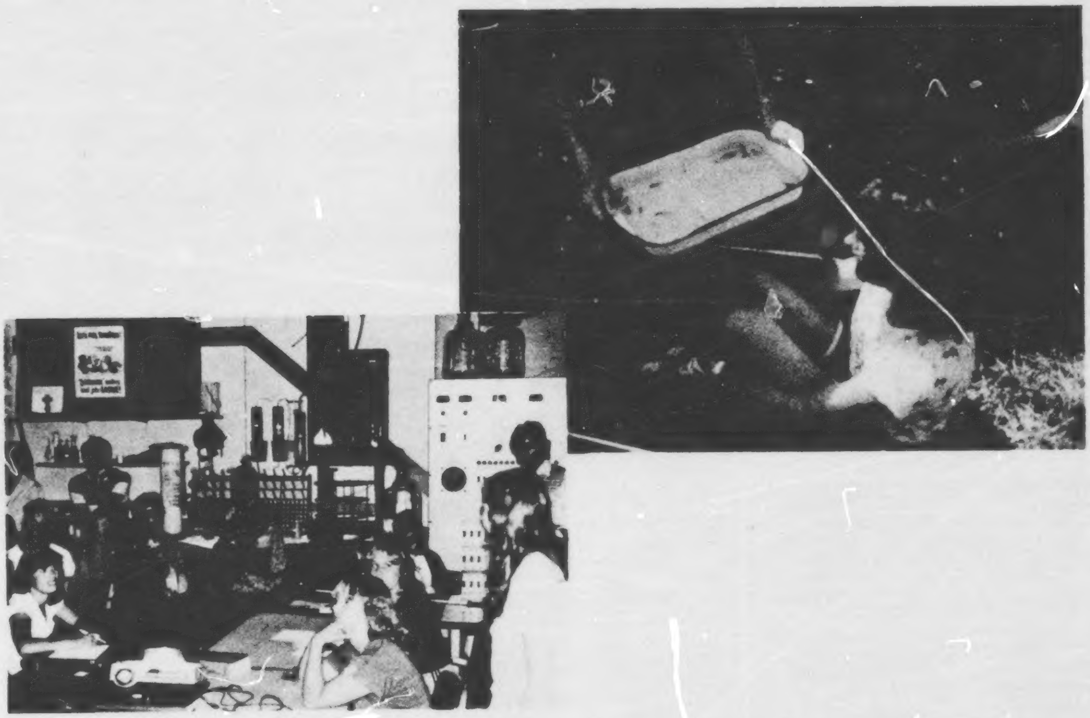
Most of the younger staff were not necessarily prepared by the in-service training to deal with the range of social and emotional demands placed upon them. If the directors conduct a program of this nature again, this will be an important aspect to cover in the pre-service session.

In the afternoon of the second day, the counselors familiarized themselves with the physical layout of the camp and practiced caring for adult campers with cerebral palsy. While they learned the proper methods for lifting and lowering non-ambulatory individuals, here again, one afternoon could not totally prepare them for a full 4 weeks - 24 hours a day of this work. Nevertheless, this prior exposure assisted them to be at ease with the youngsters when they did arrive.

The entire third day of the program was devoted to proper methods of caring for individuals in accident situations out-of-doors. This overview included an explanation on epilepsy as well and its care. Fortunately, poison ivy and two scratches on the finger were the extent of the first aid needed at camp. The counselors met in the nurses center during this pre-service session. All medications taken by the campers were supervised by these individuals, who were on call in their quarters throughout the entire month.

A more rigourous pre-service training session for a program of this nature is suggested by the analysis of the Staff Evaluation Form(see Table VI ,p.126). The project directors feel that this response reflects more clearly a realization on the part of the staff that they were inexperienced in the needs of the students at the onset, rather than a real need for a more intensive type of training for a short term program of this nature.

CURRICULUM



II. CURRICULUM

A. Academics

A copy of the schedule of activities for each session can only give an overview of the program as implemented. (See Appendix III). This section of the final report will examine in more specific detail the objectives of each academic activity and the procedure which was utilized.

The goals of the program were not to teach the students the details of flora and fauna which exist in the southern Illinois region - but rather to assist them to understand fundamental principles of ecology, especially by showing them examples of these principles in the living environment. Students were asked to complete a pre-test instrument of their knowledge of these principles upon entry into the program, and this same instrument was used to evaluate cognitive outcomes of the work-shop. The amount of time devoted to instruction in each of thses principles was not equal, nor was it designed to be. See Table I for Total time devoted to instruction in the institute. The nature of the methodology employed in teaching these concepts also varied. As the plan on page 22 indicates, three major instructional approaches were used; 1) lecture, 2) field experiences, 3) films.

Approximately 120 instruction hours were spent in direct contact with the concepts covered in an ecological foundations course. If this same amount of time were spent by the student of a series of ideas during the course of a regular school term,the instructor would have in front of him an outline for a full semester of study. It should be pointed out that the students in the program participated not only from interest in the subject, but also for the opportunities offered to them for camp-like study experience. In reality they did little independent studying outside of the structured lecture and outdoor labs.

Table II on p. 23 indicates where the emphasis was placed through lecture, discussion and concrete example upon each of the subordinate concepts in ecological foundations. At all times, the emphasis was placed upon understanding the process of ecology, rather than upon memorizing terms for plants or animals.

We will return to Table II when the section on Evaluation is covered.

Table I

Time Spent in Instructional Activities

Total instructional time:	60 hours
lecture	19 hours
films	6 hours
laboratory work	4 hours
field work	29 hours
testing	2 hours
Total instructional time on field-related skills:	15 hours
swimming instruction	2 hours
canoeing instruction	2 hours
rapelling instruction	4 hours
paper-making	3 hours
construction of bluebird boxes	4 hours

In general, each day of the program began with an introductory lecture which outlined the basic concepts which would be studied in the field that day. After the introduction students moved into the field for an outdoor game or demonstration which related the concepts discussed to the reality observable in the natural environment.

This heavy emphasis upon hands-on experience was specifically designed for students who it is felt suffer more completely that the average students from a lack of frequent direct contact with the environment. There were at least two activities of this nature everyday.

Table II

Instructional Time on Each Ecological Principle*

Topic	Time
A. Individuals and Population	18 hours
B. Interactions and Interdependence	28 hours
C. Environmental Influences and Limiting Factors	15 hours
D. Energy Flow and Materials Cycling	18 hours
E. The Community and Ecosystem Concepts	15 hours
F. Homeostatis	12 hours
G. Succession	7 hours
H. Man as an Ecosystem Component	7 hours
I. The Ecological Implications of Man's Activities	8 hours

*most lectures and activities taught more than one principle at a time, therefore the total hours does not equal 120.

Approach to Lectures

The introductory lecture was accompanied each day by a series of large print notes and diagrams which the students received. While the lecturer utilized films and the overhead projector to explain these concepts to normally sighted and hearing students, the sign interpreter stood in the front of the room, explaining each point to the youngsters with hearing impairment. Each student received a set of vocabulary words which they defined during each day's lecture session. A tutor-counselor sat with each blind youngster tracing out diagrams on the palm of his/her hand, describing visual supplements in greater detail or assisting with the recording of lecture notes by cassette recorder. The ratio of one counselor to every three students was maintained at all times, frequently supplemented by local high school students. These volunteer-aides took notes for students who did not have the full use of their hands and assisted wheelchair-bound and blind students to move through their activity-filled day more smoothly.

Lecture Topics

I. Energy Flow

- Everything is interrelated.
- One aspect of interconnectedness is energy flow.
- All of the energy comes from the sun.
  - Effects on non-living components:
    - Heat, wind, rain, ocean currents, and waves.
  - Organisms also require energy:
    - Energy made available by photosynthesis.
    - Food chain shows energy path.
    - Food web is more complete diagram.
- Energy can be converted from one form to another:
  - Light, heat, chemical energy, movement, etc.
- Energy conversion are inefficient.
  - Sun to plant only 1% efficient.
  - Plant to Herbivore only 10% efficient
  - Herbivore to Carnivore only 10% efficient
  - Plant or animal to decomposer only 10% efficient.
  - During conversions, most energy is lost to outer space as waste heat.
  - Food pyramid depicts energy loss.
    - More people can live at the end of short food chains.

II. Material Cycles

The same materials are used over and over again, endlessly.

The most common elements in living things are carbon, gen, oxygen, nitrogen, and phosphorus. The cycling of these materials was examined.

III. Lake Ecosystem

These terms were defined: organism, population, community, and exosystem.

Physical characteristics of water and their effects on organisms: viscous, transparent, low in oxygen and nutrients, slow to change temperature, ice floats.

Seasonal changes in a temperate lake.

Zones of the lake and characteristics of organisms in each zone.

IV. Role of Bacteria and Fungi in Ecosystem

Some few cause disease, others participate in human activities such as brewing, baking and making cheese; however, most are organisms of decay.

V. Major Terrestrial Ecosystems

The effects of temperature and precipitation as controlling variables in deserts, grasslands, decidous forest, taiga, tundra and tropical rainforest was discussed, along with characteristic adaptations of organisms in these ecosystem types.

VI. Forest Ecosystem

Forests require more moisture, fewer and smaller fires than grassland. They are deciduous because of cold, short, cloudy, windy days in winter, and because snow accumulation on leaves would break branches.

VII. Populations

These characteristics of populations were discussed:

birth rate, death rate, immigration rate, emigration rate, growth rate, age structure, limiting factors, law of the minimum, law of tolerance, carrying capacity, niche, and microhabitat.

III. Succession

Succession was difined and illustrated with these examples:

Bare rock → lichen → moss → cushion plant → alpine turf

Stream → beaver dam → beaver pond → silted pond → beaver meadow

Field → abandoned field → annual plants shrubs → small trees → oaks and hickories

IX. Species Interactions

Predation, parasitism, commensalism, competition and symbiosis were described and discussed.

X. Human effects on natural ecosystems

Population increase

Habitat destruction

Air and water pollution

Resource depletion

Movement of nutrients from land to water

Supplemental Films

To supplement the ecological concepts covered in lecture during the first session of the Institute, a series of captioned films were available to the hard-of-hearing students, who did not find the regularly scheduled films helpful. However, these films were not viewed by students in the second session, since the only hard-of-hearing student was able to absorb much of the regular films.

The regular films viewed by the students in each session included:

Title	Ecological Concepts Explored
1. "Mzima, Portrait of a Spring"	Ecosystem
2. "Baobab, Portrait of a Tree	Community
3. "Land Use, A Moral Dilemma"	Effects of Man
4. "Say Goodbye"	Food Chains, Effects of Man on Ecosystem Materials Cycle

ENVIRONMENTAL AND ECOLOGICAL OUTDOOR ACTIVITIES

During the planning stages for this Summer Institute, a number of outdoor activities, which emphasized student involvement and regularly used in the Environmental Education Curriculum at Touch of Nature, were chosen to be utilized for the handicapped students. These short, high-impact learning activities have been developed, (or adapted from other sources), by staff for use in Touch of Nature programs to provide the opportunity to study specific ecological concepts, and environmental problems by utilizing an active "hands-on" approach to learning. The Environmental Education programs at Touch of Nature, under Mr. Culen's direction, have earned the Center recognition as a National Environmental

Education Landmark by the National Park Service, (1972), as one of the best environmental Education (EE), programs in Illinois, according to the Illinois Office of Education (1979).

Many of the activities utilized for the N.S.F. Institute are written in a standard format, and can be adapted for lesson plans by a wide range of teachers in various locales. Most of the activities also follow the "Goals for EE Curriculum Development" by Hungerford, Peyton, and Wilke, and are so marked in the upper right hand corner as to goal level and concept emphasized.

The following list of activity abstracts briefly describes the activity content. Asterisked (*) activities indicate that the lesson plan can be found in the following pages of this report. Activities are listed in the order of presentation during the two-week session.

ACTIVITY ABSTRACTS

*1. Who Eats Whom? - Students play a modified game of tag which simulates a food chain. Energy flow, energy pyramids, and food chains and web chains are discussed as related to the game results.

*2. Aquatic Food Chains - Students collect and identify various pond organisms and identify their place in the pond food chain or food web. Through study of these organisms, their inter-relationships, and energy transfer between them, students learn how an ecosystem maintains its stability.

3. Recognition of Flowers & Plants/Pressing Specimens - Various specimens of pressed plants were examined and a demonstration of how to properly press and preserve plants was given. All materials for plant pressing were made available to the students so that they might produce pressed specimenns of their own. Collecting ethics were also discussed.

*4. Rotten Log Study - This study focuses on the concepts of biochemical/nutrient cycling and microcommunities by allowing the students to carefully dissect a rotting log. Students collected, identified, and then released organisms found in or under the log, and made notes on i

ACTIVITY ABSTRACTS
Continued

*5. Water Quality - Students collect data on major physical parameters of aquatic ecosystems, utilizing a water testing kit. Then utilizing federal water standards along with other guidelines, the students evaluate and suggest possible remedial actions for the aquatics system under study.

*6. Fish Management in Farm Ponds - Students sample the fish population in a farm pond and from a worksheet (provided) determine the appropriate management techique for optimum fishing. Alternative management techniques and ecological factors affecting the fish population are discussed.

*7. Garbanzo Bugs - A number of garbanzo beans are distributed in a small area to simulate a natural population. Students estimate population density of the area by sampling small portions of the population. Students examine factors affecting population density and examine how population density affects the environment. Through discussion, this information is related to human populations.

8. Examination of Bird Species and Specimen Preservation Demonstration - This particular activity allowed students to get a first hand look at a few of the bird species formed in this area through the use of museum specimens. A demonstration of how to properly skin and preserve a specimen was given. Discussion on collecting ethics, permits and laws were also discussed.

9. Nature Center Tour - A tour of the Touch of Nature Center was provided and students examined mammal specimens found in the Nature Center and were given a gerenal interpretation of the natural history of Southern Illinois.

*10. Plant Communities and Succession Trail - Students were taken on a guided "Secondary Succession Trail" at Touch of Nature (see enclosed trail guide.) This trail takes students through a recently abandoned farm field, and a series of areas representing the various stages of secondary succession until finally they come to a natural Oak-Hickory climax communtiy.

11. Quadrat Study - This activity allows students to actually count and identify various species of trees in the forest community in order to determine species dominance. This activity is designed to be used with the Succession Trail (above) to provide students with a better idea of climax community and why some trees dominate.

*12. Goober etus - Students simulate a population of predatory animals searching for their prey - Goober etus (i.e. peanuts, a population of which has been placed in a suitable habitat.) The success rate of the students and their effect on the prey species is graphed, revealing several actual predator/prey relationships.

ACTIVITY ABSTRACTS
Continued

13. Owl Calling - By using previously recorded tapes, several species of owls found in the area are called to various sites at Touch of Nature. Besides getting an opportunity to see some of these nighttime predators, students are given an interpretation concerning the natural history of the various owl species.

*14. Wildlife Management - Evaluation and Management of Limiting Factors - Students evaluate a particular site for its quality as wildlife habitat. Key factors which limit wildlife populations are examined, and a management plan to improve the habitat is designed. The management plan was then implemented and included construction of brush piles, food plots, and bluebird boxes.

WHO EATS WHOM?

GRADE LEVEL:

SUBORDINATE EE GOALS LEVEL I
ECOLOGICAL FOUNDATIONS B, D

1-8
(5-8) denotes 5th through 8th grade only

MAJOR INSTRUCTIONAL GOAL:

To help students understand the concept of a food chain and how energy flows through the different trophic levels of that food chain.

ASSOCIATED CONCEPTS:

A. Producer
B. Consumer
C. Decomposer
D. Food Chains and Webs
E. Energy Flow and Energy Pyramid
F. Predator-Prey Relationship

SKILLS:

A. Observation
B. Classification
C. Inferring
D. Communication
E. Formulating Models

BEHAVIORAL OBJECTIVES:

Upon completion of this activity, the student will be able to...

1...give an example of one food chain that is likely to be present in the study area and identify the producers and consumers of that food chain.
2...describe the role of the decomposers.
3...define and identify the primary, secondary, and tertiary consumers in a food chain. (5-8)
4...give one example of a food chain where man is a member
5...demonstrate how energy flows from one organism to the next by diagramming and labelling an energy pyramid.
6...give one example of a predator-prey relationship.

BACKGROUND INFORMATION:

All living things require energy which is supplied by the sun. The sun's energy is converted to food energy by producers, which are the green plants. Consumers are those organisms that obtain their energy through the consumption of plants and/or animals. Several levels of consumers exist. Primary consumers (herbivores) feed on plants. Secondary consumers (carnivores) depend on primary consumers as their energy source. Finally, tertiary consumers (top carnivores) obtain their energy from secondary consumers. Example:

marshgrass → grasshopper → shrew → marsh hawk

(producer) (primary consumer) (secondary consumer) (tertiary consumer)

This flow of energy from one organism to the next is known as a food chain. (A food web is the total pattern of all separate food chains in a community. An example of a food web is given in Appendix B). Each step in a food chain is called a trophic level. One organism may occupy different trophic levels in different food chains. For example: rice → man (man is a herbivore); grass → cow → man (man is a carnivore). When an organism eats both plant and animal matter, like in the case of man, it is known as an omnivore.

The final major feeding group are the decomposers. Decomposers are organisms that feed on dead organic matter. Their basic function is to breakdown dead matter, releasing nutrients back to the mineral cycle. Therefore, the work of the decomposers is just the opposite of that of the producers, who fix nutrients and energy into plant biomass.

With each transfer of energy (or with each successive trophic level) energy in the form of heat is lost (second law of thermodynamics). On an average, 90% of the total energy or biomass consumed is lost and only 10% is used for growth or reproduction. Therefore, there is less available energy to organisms at the beginning. This concept of energy loss can be illustrated by an energy pyramid (Appendix A). The pyramid aids in visualizing the energy loss occuring at each trophic level.

The predator-prey relationship can also be worked in when studying food chains, a predator being an animal which captures and feeds upon other animals (prey).

THE ACTIVITY

A. Information

1. Learning Site - An area approximately 50 feet by 50 feet.

2. Materials - Popcorn or some other small materials such as wood chips or leaves to represent plants, yellow, blue, and red colored tags or streamers (these identify what role the child is playing). If tags are used, pins are needed to secure the tags to the student's clothing, small paper bags, chalk board, and an energy pyramid should also be diagrammed or constructed (5-8).

3. Preparation by Instructor - Select an area, pop the popcorn, mark paper bags with a line 1 inch or so from the bottom, diagram a food chain and an energy pyramid (5-8).

4. Critical Vocabulary - Producers, consumers (primary, secondary and tertiary-5-8), decomposers, food chain, predator, prey, energy flow.

5. References, Tips, Hints, Worksheets, or Handouts

   1. Food Chain Game, an OBIS activity
   2. Chain of Life, a CWES activity

3. The Biological Sciences, Frazier and Smith, IL, Laidlaw Brothers, 1974.
4. Ecology and Field Biology, Smith, N.Y. Harper and Row, second edition, 1974.
5. Ecology, Odum. N.Y. Holt, Reinhart, and Winston, 1963.

B. Directions for the Actual Learning Activity

1. Focus - Take children to the site and have them sit down. Explain how energy flows through the ecosystem (sun → plants → animals, plants and animals die → decomposers → basic raw materials → plants). Introduce the terms producers, consumers, and decomposers. Introduce the idea of a food chain and show a diagram of the food chain that is used in the activity (clover → cricket → frog → hawk) so they can visually see the relationships. Give other examples of a food chain i.e. apple → man; grasses → rabbit → dog, and have the children identify the relationship of predator-prey again using the food chain that is in the activity.

2. The Activity - The students will simulate a food chain (grass → crickets → frogs → hawk). Divide up the students into three equal groups and pass out the colored tags to each group. Each color will correspond to one member in the food chain. i.e. cricket-blue, frog-green, hawk-red. Each group should have a home base where it cannot be caught by any other animal. Spread these bases around the perimeter and spread out the popcorn in the middle which represents the grass. All of the animals must capture some food within two minutes and go back to their home or else they will starve. The crickets must get enough popcorn in their stomachs (paper bags) to reach the line, a frog must capture one cricket, and each hawk must eat one frog. In order to get another animal they must tag them. Make sure you do not let the children run in the tag game or else someone will get hurt. Instead have them hop or crawl. Once an animal is eaten he must go to the decomposition area on the side of the game area.

   Play the game once with equal numbers of each animal. The frogs will all die in 95% of the cases. Ask the frogs why. Too many hawks and not enough crickets are two common responses. Make these adjustments by changing some of the hawks and crickets. Play the game again.

   Gather the students after this game and discuss the results of both games. It may be played again if time permits.

3. Synthesizing Strategy - At the end of the activity, have students gather back to central area to discuss:

   1. The animals you played in the food chain had to do two things to live. What were they?
   2. What animals were predators in this food chain? What was their prey?

3. Was it harder to be a frog or a hawk? (frogs and crickets had to worry about their predators as well as gathering food; hawks had no predators, but had a smaller available food source).
4. What is the relationship between the numbers of organisms at each trophic level and the ability for all the populations to survive.
5. What happened to the frog's body after the hawk ate it? (What is the role of the decomposers?)
6. Name a possible food chain that could exist in this area. Point out the producers and consumers of the suggested food chain. For 5-8, have students define and identify the primary, secondary, and tertiary consumers. Form a food chain chorus (this is for all grade levels).
7. (5-8) Why were there more crickets than frogs? Introduce energy pyramid and explain how energy flows through the food chain, losing energy in the form of heat as it is transferred to each trophic level. Why were there more frogs than hawks? Do hawks need plants to survive? Form an energy pyramid using the same food chain that was in the game or using a suggested one.
8. Have the students construct a food chain with 5 levels, 10 levels, 15 levels. Tie in energy transfer and loss with the idea that there is an upper limit on the number of levels that can exist in the chain.
9. Where does man fit in the food chain? If they are having trouble, ask for their favorite food and work from there.

Food Chain Chorus - Divide the group into three categories - producers, consumers, and decomposers. Have the whole group form a circle, but keep producers together, consumers together, and decomposers together. Producers will rapidly chant "produce" in a high pitch, consumers will rapidly chant "consume" in a low pitch, and decomposers will chant "de-com-pose." It is chanted with the first syllable, de, in a high pitch held for 1 count and the last two syllables, com-pos, going down the scale with each syllable held 1/2 beat. In other words, de is a high 1 count note, com is a mid 1/2 count note, and pose is a low 1/2 count note. They chant together. Make a symphony out of the food chain.

Human Energy Pyramid -Ask for an example of a food chain. Line four students side-by-side on their hands and knees for the base (producers). Put 3 students on top of them for the primary consumers, 2 students for the secondary consumers, and 1 student for tertiary consumer. Have the rest of the group represent the sun. Again, discuss energy flow.

Suggestions on Time and Problem

If you run short of time, go out and find a food chain in the area. Some possible food chains in the area are:

Persimmon → man, acorn → squirrel → dog, (fallen log) → mushrooms → insects → toad or snake, milkweed → butterfly → bird

Use caution and good judgement in the activity. In a very active group make sure that they crawl so no one gets hurt. Make sure after each game you go over who survived, starved, or was consumed. Make sure the students understand that it is the survival of the population that is important and not each individual organism.

AQUATIC FOOD CHAINS

GRADE LEVELS:

4-10

SUBORDINATE E.E. GOAL: LEVEL I
ECOLOGICAL FOUNDATIONS A, D, E

MAJOR INSTRUCTIONAL GOAL:

1. To help students understand how food chains or webs function within an aquatic ecosystem.
2. To make students aware of the energy relationships within a community and the importance of these relationships to the balance of that system.

ASSOCIATED CONCEPTS:

A. Producers, consumers, decomposers
B. Predator - Prey relationships
C. Trophic level
D. Energy Flow
E. Populations
F. Communities
G. Nutrient Cycling
H. Homeostasis

SKILLS:

A. Collection techniques
B. Observation and identification of pond organisms
C. Comparison of the different forms of aquatic life
D. Classifying the various organisms into groups
E. Synthesizing data collected so that the students conceptualize the energy systems operating in an aquatic ecosystem.

BEHAVIORAL OBJECTIVES:

Upon completion of this activity, participants will be able to ...

1...identify at least one food chain and indicate which members are producers, consumers, or decomposers, and why.
2...identify one predator and one prey species and the importance of that predator to the dynamic balance of the community.
3...describe how energy flows through the system indicating the ultimate energy source and energy utilization by the various organisms.
4...correctly identify at least two invertebrates that were collected in the pond. (The students can use a pond guide or Fresh Water Invertebrates of the U.S. by Pennak)
5...demonstrate a knowledge of proper collecting and release methods while using the equipment provided for this activity.
6...provide several examples of interrelationships existing within the pond community.

BACKGROUND INFORMATION:

This activity is designed to give the students a better idea of the food relationships that exist within an aquatic ecosystem. Many people see the game fish that a pond produces but few take a closer look at the many organisms making up the complex food webs that support the fish populations.

The ultimate energy source for all the organisms in the pond is the sun. Various types of green plants utilize the sunlight to produce their own food. The producers can fall into a number of different categories: emergents - those plants extend out of the water (cattail, buttonbush), floating plants - rooted plants which extend to the surface but not above it (water lilly, water primrose), submerged plants - rooted plants which do not reach the surface (widgeon grass, pond weed), and phytoplankton - the microscopic free floating plants also called algae. Defined zones exist in the pond corresponding to the type of plants that are found.

Animals that feed on the producers are called primary consumers. Secondary consumers feed on the primary consumers. Tertiary and fourth order consumers may also exist within the pond. Each consumer lives in a certain zone depending on depth, food, and cover. The larger bass live in the deeper section while water striders live on the surface near the shore.

The last major category is the decomposers which consist mostly of bacteria and fungi. These organisms break down the dead organic matter or detritus into nutrients which is then recycled by the producers. A common food chain found in ponds in southern Illinois is algae → water boatman → dragonfly nymph → bluegill → large mouth bass.

There are a number of factors that influence the amount and types of organisms that an aquatic community will support. It is important to understand the major factors and to be able to communicate to the students just how these factors fit together to form a balanced community. Vertebrate, invertebrate, and plant populations in a pond are not only influenced by the size of the pond but by a variety of factors including soil fertility, water depth, turbidity, temperature and water quality. Various populations are also affected by the relationships within the pond's food web. Take for example fish populations, as you know various fish species have different food requirements. A bass would require small fish and larger invertebrates such as crayfish. A bluegill would depend on small invertebrates such as aquatic insects, or zooplankton and to some extent would eat plants or phytoplankton. Therefore, the number of bass and bluegills that pond could support would directly depend on the amount of food available to them and this would be determined by the abiotic factors mentioned above. It must be understood that a pond like other communities will have a balance between predators and prey and this balance is necessary to maintain the homeostatic nature of the pond.

It can be said that a pond maintains a state of dynamic equilibrium. From new ponds to very old ponds or lakes, numbers and species of organisms within the system constantly change. Populations increase or decrease depending upon food supply and other biotic as well as abiotic factors. Even with this dynamic system a state of equilibrium is almost always maintained through a variety of self regulating factors that include predator-prey relationships, mortality, natality, amount of cover and fertility.

This is a basic description on aquatic ecology. Further information can be found in the references listed in the Activity Information #5.

THE ACTIVITY:

A. Information

1. Learning Site - Any pond that contains good vertebrate and invertebrate populations. Use caution when taking students around the ponds. Make sure all teams remain in view.

2. Materials - Equipment needed per team

   Students

   - 1 dip net
   - 1 magnifying glass
   - 1 quart jar
   - 1 pond guide
   - 1 set of tweezers
   - 1 pencil
   - 1 data sheet
   - 1 clipboard

   Instructor

   - 1 large dip net and seine
   - 1 sieve
   - 2 white bottomed containers
   - Food Chain Board or chalk board

3. Preparation - Gather all your equipment together before beginning the activity. Make sure students have been properly instructed in the use of the equipment and pond guides. If possible, sample the pond ahead of time and identify all unknown species. Also find out when the pond was stocked and with what types of fish.

4. Vocabulary

   phytoplankton
   zooplankton
   algae
   invertebrates
   vertebrates
   producers
   consumers
   decomposers
   homeostasis
   dynamic equilibrium
   food web
   food chain
   food pyramid
   trophic levels
   habitat
   populations
   energy
   nutrients

5. References, tips, hints, worksheets, or handouts

   a. Aquatic Plants of Illinois Glen S. Winteringer, Illinois State Museum
   b. Fresh Water Invertebrates of the U.S. Pennak
   c. Ecology and Field Biology by Robert Leo Smith, pages 62-85
   d. CWES Pond Discovery Activity - Who Eats Whom
   e. Management of Lakes and Ponds by George W. Bennett

   Make sure all equipment is available and in functional condition. Be prepared to show students how to correctly use the equipment and emphasize the importance of returning specimens alive.

Handouts provided - 1. Pond Guides (one per student), available from O.B.I.S. (Outdoor Biological Instruction Strategies) make sure these are returned.
2. Data sheets

B. Directions for the Learning Activity

1. Focus - Take the students to the pond to be sampled. Ask the students where the energy needed to support the system comes from. Also, ask them about other factors that might influence such things as plant growth, fish populations, water temperatures, fertility, etc. (Such as water clarity, predator-prey numbers, shoreline vegetation, surrounding soils.)

   Use the food chain and food web boards to point out the various organisms that exist within the pond or lake. Explain some of the food relationships that exist among these creatures and emphasize the fact that millions of smaller organisms support a small number of fish because of the loss of energy between trophic levels (e.g. by respiration and movement). Show them the food pyramid chart so that they can get a better idea of the energy flow and the numbers of smaller organisms required to support a few larger organisms in the higher trophic levels.

   Explain to the students that they are to capture and identify (by using the pond guides) organisms (plants or animals) that are part of the food chain or webs in this pond. Emphasize the fact that the creatures should be placed unharmed in the pint jars so that they can be returned alive at the end of the activity. They should only keep one of each species.

   Divide students into teams of two. Explain to the students that they are working on a buddy system and that each student must assume responsibility for his teammate!

   Pass out the pond guides, equipment, data sheets, pencils and clipboards. Demonstrate how to use the collecting equipment and how to handle the organisms after capture. Explain how to use the pond guide and data sheet to identify and record all organisms.

2. The Activity - The teams will now find and identify at least two organisms. Tell the students to disperse around the pond. Move from team to team assisting the students in collecting and identification. Help the students identify producers, consumers, and decomposers. (To do this the students should use their magnifying glasses.) Ask them to note such things as size, color, mouth parts, any special appendages, and locomotion. See if they themselves can determine what function each organism serves. If they find it difficult to identify producers or consumers, refer to the pond guide which will give them some help.

Make sure students are handling specimens and equipment correctly. Do not let them over collect; one example of example of each organism will be sufficient.

Call the students together after the collection time is up. Ask several of them to pour the contents of their jars into a white enamel pan. Take the whole group back to the shore and collect several bottom samples using the large dip net. Run these samples through the brass sieves to remove debris and examine each sieve for possible organisms. If necessary wash the contents of the finest sieve into an enamel pan so that you can take a closer look.

Have the students gather round for a closer examination of the specimens.

3. Synthesizing Strategy - Ask students to identify some of the specimens in the enamel pans. Also have them classify each organism in terms of its position in a food chain, (consumer, producer.) After the students have identified all they know, look at the food chain board and see what members are missing from their collection, (possibly algae, zooplankton, and fish.) Try to point out these missing organisms and try to find out why they were not collected. Review the idea of the food chain and the energy flow within it, pointing out the energy source, producers, primary and secondary consumers.

   Now pick up the food web board and ask students to identify as many predator-prey relationships as they can. (Use yarn to interconnect the relationships.) Explain the difference between the food chain and food web. Emphasize the fact that most aquatic systems are actually many interconnecting food relationships that form a dynamically balanced community represented in a food web. Point out the fact that disruption or removal of just one part of the pond community could have disastrous results on all levels of life. Ask students just how the balance of the pond could be altered. Have them give specific examples and the effects that each might have on the food web. (e.g. insecticides, dredging, overfishing, cattle in a pond, or fertilizers)

   Return all creatures back to the pond noting that each individual has his role in the pond community. Try to release creatures in the same areas they were taken. Gather up all gear and return to main camp area.

4. Suggestions on Time and Problems - Spring, Summer, and Fall should produce plenty of aquatic organisms in any of the ponds in the area. Beware of high water and muddy conditions; this may hamper collecting and present a hazard when students work around the ponds.

   Be organized! The students will know if you have not prepared for this activity.

Students may start to collect and ignore identifying the organisms. As you move from team to team, emphasize the importance of identification before they continue to collect. If they become frustrated in identification, help them out. Point out various parts of the organism that are characteristic, and help them determine what that organism might eat so that they can classify it in a food chain.

It would be most beneficial if you could sample the pond yourself before the group arrives; that way you will know just what to expect and where to find certain things.

ROTTING LOG MICROCOMMUNITIES

GRADE LEVEL: 6-12

MAJOR INSTRUCTIONAL GOAL: To help students understand one process of decomposition through observing characteristics of a rotting log microcommunity, the community the log came from, and agiotic factors affecting these communities and member species.

ASSOCIATED CONCEPTS:

A. Decomposition
B. Niche
C. Habitat
D. Microcommunity
E. Community
F. Food chains
G. Abiotic factors
H. Biogeochemical cycling
I. Energy transfer

SKILLS:

A. Observation
B. Identification
C. Comparison
D. Concluding and infering
E. Synthesizing

BEHAVIORAL OBJECTIVES:

Upon completion of this activity participants will be able to ...

1...identify 3 general characteristics of the community in which this rotting log microcommunity is found.
2...provide 3 specific examples of how this microcommunity exists as an important part of the surrounding forest community.
3...identify and compare 3 discrete habitats associated with this rotting log microcommunity.
4...identify the major orders of organisms associated with this rotting log microcommunity.
5...identify the dominant species associated with the rotting log microcommunity.
6...draw conclusions and state inferences concerning the abundance of invertebrateds, as compared to vertebrates associated with this rotting log microcommunity.
7...identify 3 niches associated with this rotting log microcommunity, briefly describing each.
8...predict what would happen to specific population (ex. earthworms, centipedes, beetles) in the surrounding forest community, if for some reason the number of rotting logs suddenly doubled in number.
9...explain how a rotting log could be considered a "producer" in some food chains.
10...describe or diagram 2 food chains (ie.containing a producer and at least two consumers) associated with this rotting log microcommunity.
11...identify and describe the effects of 3 abiotic factors which affect the presence of organisms within this rotting log.

12...explain why the term 'microcommunity' might be less appropriate than 'ecosystem' to describe a rotting log.
13...predict how many years it will take for the complete decomposition of this rotting log microcommunity as compared to the longevity of the surrounding forest community including the basis for this prediction.
14...identify or infer the presence of 3 organisms which act solely as decomposers within this rotting log microcommunity.

BACKGROUND FOR THE T.O.N. INSTRUCTOR:

The productivity of a forest, though influenced by other organisms, is largely determined by physical factors including soil (nutrients), temperature (heat energy), light (insolation) and available moisture. A deciduous forest (ex. oak-hickory) usually contains a limited number of seasonal plants, with the majority of biomass (live organic matter production) associated with woody plants.

As these woody plants die and fall to the forest floor, the stored nutrients are recycled, while the stored energy is gradually degraded through use by a variety of organisms. In fact, it has been estimated that up to 90% to 95% of a woody plant's stored energy is consumed by detritus feeders and decomposers. These organisms usually actively assist in the breakdown of many complex compounds stored in woody tissue. Often the simpler substances produced can again be utilized by the living producers within the surrounding forest community. Detritus feeders and decomposers play a major role in the deciduous forest filling both energy flow and nutrient recycling positions in forest food chains - benefiting consumers and producers alike.

Within the context of the surrounding forest community, the degradation or expenditure of stored energy associated with any food chain is completed within the decomposition process. The sequence of transfers within this decomposition process is better known as a detritus food chain, It is one index of the conditions within the forest community in that it reflects the final series on interactions among various local species population. For example, the first few centimeters of topsoil are often rich in invertebrate life, including earthworm, centipedes, slugs, grubs and beetles. These organisms assist both in the decomposition of general forest floor litter (detritus) and more specifically fallen logs. Members of the detritus food chain may also interact directly and indirectly with producers and consumers found in surrounding forest community.

The existence of many organisms within the rotting log micro-community depends upon the specialized conditions that may develop surrounding, on the surface or within that log. Moisture and temperature, for example, may vary greatly from the top of the log to it's underside which favors invertebrate populations. The populations of invertebrates will in turn support a variety of predators including larger insects, salamanders and rodents. Also, the log surfaces, as a habit is likely to vary not only with physical condition, but from season to season. Species of slime molds, mushrooms and other fungi, lichens and moss are likely to appear at different times, both decomposing the log and altering surface conditions for other species. Perhaps they will retain moisture needed by bacteria. In drier parts of the log, spiders may weave a home, chipmunks claim a cavity, or other organisms find a temporary place to hike. The presence of these organisms will attract visitors, after predators, whose signs may be observeable around the log. Because of the pervasive influence of abiotic factors upon the log, it is more appropriate to term it an ecosystem.

Concerning the microcommunity itself, the size of the log is a major determinant of the number of species that can be supported. Also the populations of these organisms are likely to be affected by the volume of wood involved. However, as is the rule in ecology these generalizations may be too simplistic. Other variables are also critical with regards to a species' habitat. These variables include the stage of succession (early, middle or late stage of decomposition); where the log fell in the forest (in the shade? touching the ground?) and even the species of tree represented by the log. (density and porosity varies among tree species). Also, fluctuations may take place in local abiotic and seasonal patterns. The resulting fluctuations in member populations affect the rates in which stored energy is consumed and stored materials recycled within the rotting log microcommunity. Generally speaking, the greater the number of organisms, the faster the rate of decay. This would be particularly true in the case of decomposer organism populations (ex. bacteria, fungi).

Having students directly observe a rotting log microcommunity should help them further understand the nature of material recycling within a forest community. Simarly they should begin to conceptualize the very limited existence the log has as more and more of its stored energy is transferred to other or organisms associated food chains and webs. This rotting log will one day 'disappear' from the forest floor just as leaves and small twigs do. Perhaps of even greater importance is the idea that much of the original wood material has been converted to chemicals that are now contributing to the growth of other green plants within that forest community.

THE ACTIVITY

A. Information

1. Learning site = pre-select appropriate local sites
2. Materials - three sets of observation sheets, one copy of 'A study of a Rotten Log' per participant, tweezers, hand lens, small containers, pillowcases, one thermometer per group, pencils.
3. Preparation by the instructor - read background material thoroughly and review activity sequence. Have all handouts and study resources prepared in advance. Be familiar with several rotting log sites within the local area, and history of log fall if possible. If the main group of students is large (6 or more) be prepared to breakdown into smaller groups, each having its own rotting log to study.
4. Critical Vocabulary - community, microcommunity, biotic and abiotic factors, ecosystem, decomposition and decomposers, detritus, humus, deciduous, dominant organism(s), habitat, niche, energy transfer and flow, material recycling.
5. References - A. Concepts; Rickets Ecology; E. odum Ecology; E.Kormondy Concepts in Ecology; R.L. Smith Introduction to Field Biology and Ecology; Berton and Werner Field Biology and Ecology; H. Hungerford and R. Peyton Teaching Environmental Education (Ch 2) B. Activities: H. Hungerford et.al. Ecological Resources of Southern Illinois p. 6-20; Project Learning Problems: Succession in the Microcommunity: The Fallen Log. OBIS: National Recycling in Soil (I); Litter Critters (II); Logs to Soil (IV). C.

Field Guides Golden Series: Insects, Trees: Petersen Series: Insects, Trees and Shrubs, Animal Tracks; R.B. Swain: The Insect Guide.

B. Directions for the actual learning activity

1. Focus - time 30 minutes

a. Initiate a discussion among participants about their home towns as communities, utilizing the habitat (where they live) and niche (what they do) concepts. Following this, introduce the community concept from a nonhuman (plant and animal) persective.

b. Take participants to the rotting log study site. On the way ask questions of them about biotic and abiotic conditions observed in the plant communities surrounding them. Identify different communities, dominant species and common tree species.

c. On site, break down into groups of 4 to 5. Distribute the first observation sheet on Forest Community Characteristics, one to a group. This preliminary survey is conducted to help participants identify abiotic conditions in the surrounding community which may affect the log microcommunity observe and record data.

d. After recording is completed, reconvene the participants and briefly review their data. Elicit conclusions and inferences about the effect of abiotic conditions on the forest floor in general and the fallen log(s) in particular.

2. The Activity - time 30 minutes

    a. Upon completion of the focus discussion, distribute the second observation sheet on Log Microcommuntiy Physical Characteristics to each group. Explain that this observation is to be done in or immediately around the rotting log itself. Briefly define micro-community and decomposition and describe how a rotting log may be seen as an example of each. If splitting up into smaller groups, assign each group a separate log at this time. Allow 10 minutes to complete the task.

    b. Reconvene the group and discuss these results. Ask participants to compare these observations with those from the first observation sheet. Once this is completed and participants have adequately reviewed conditions, break each group down into sets of 2 or 3 participants. One set will focus on the external shell of the log, one set on internal conditions and a third on the undersides and immediate area. Distribute the necessary equipment and allow 10 - 15 minutes for this investigation. Caution participants about impact. Also hand each participant the third observation sheet on micro-community life asking them to complete it as best they can. Have the identification guides ready for use. Allot five more minutes for the recording of these observations. Now reconvene the groups.

3. Synthesizing Strategy - Briefly review the first and second observation sheets. Have the students discuss the

points, briefly summarizing the forest and rotten log community conditions.

Given that there are three groups working on discrete log habitats (perhaps on the same log) and recording observations, a synthesis and comparision is in order. First review the three different sheets from one log. If there is a second log being studied, review the data collected on it. Then have students:

1. Compare the logs' micro-communities/habitat characteristics.
2. Compare the discrete habitats in reference to size, type and number of members.
3. Compare the habitat similarities and dissimilarities from log A to log B.

As a conclusion to the synthesis, selectively review the question presented in the booklet ' A Study of a Rotting Log'. Allow enough discussion time and refrain from answering for them. Proceed slowly allowing for writing of answers, comparisons and review of observation sheets. Invite any further statements, inquires, observations and inferences about the rotting log as a dynamic community in the decomposition process.

4. Suggestions on time and problems

The choice of an area with several good log sites may be critical. The format for assigning the logs and the number to be observed remain up to the instructor, time and quality of the log sites. You may wish to visit two or more log microcommunities in the activity time. Here, comparison of data may be a useful tool. You may wish to have each group review all three habitats on one log.

Here also comparison is a likely tool after observations.

Before the synthesis encourage completion of the first and second observation sheets. They may not take as long as allotted, so move at their pace here. During the synthesis review sheets one and two if you feel it is necessary.

During the final discussion review of each question may be helpful, but not necessary . During all discussions help students distinguish among data, conclusions and inferences.

Reinforcement of cooperation, teamwork and communication may also be necessary, but don't force this. Remind them that they are to record and present their findings. Allow them enough time for both observation and recording presentation.

WATER QUALITY

By James Jordan

INSTRUCTIONAL GOAL:

To help participants understand the nature of water and water pollution through the use of a water testing kit. Using Federal Water standards and the data collected participants will evaluate and suggest remedial action of aquatic systems.

ASSOCIATED CONCEPTS!

A. Acidity, alkalinity, and pH

B. Pollution and contaminants

C. Buffer system

D. Nutrient and eutrophication

E. Biological oxygen demand, aerobic and anaerobic

F. Specific heat

G. Density or specific gravity

H. Surface tension

I. Limiting factor

Upon completion of this activity the participants will be able to:

1. explain why water is unique by naming and explaining at least three of its properties.
2. explain why power companies use water to cool generators.
3. define pollution and give three examples of both point and non-point sources of contaminants entering waterways.
4. contrast riparian and appropriative water rights by giving hypothetical example of each including equalities if one owner pollutes the waterway.
5. explain how the 1972 Federal Water Pollution Control Act would regulate a hypothetical situation of a point source.

6. define pH, acidity, and alkalinity; give the pH range in which aquatic organisms live and the consequences of having too high or low pH.
7. in simple terms describe the carbonate-bicarbonate buffer system by explaining what happens to an acid or base if it is added to the system given the equilibrium equation $CO_2 + H_2O$ or $H_2CO_3 \rightleftarrows 2HCO_3^- + Ca^{++} \rightleftarrows CaCO_3 + CO_2 + H_2O$.
8. explain the consequences of the dissolved oxygen concentration dropping below 5ppm and 3 ppm and explain how man has disrupted natural systems in this way.
9. name the two most common nutrients involved in eutrophication and explain how they enter waterways.
10. suggest ways to correct the problem (if one exists) of the water tested and name possible oppositions that might hinder its clean up.

H_2O is a very unique substance and is essential to all organisms. By examining its properties one can begin to understand why it is widely used in the industrial sector along with domestic and recreational purposes. These properties are:

1. High solvent power (almost any substance will dissolve to some extent in water)
2. Highest specific heat of any natural substance (heat required to raise temperature of a substance, very high latent heat - energy needed to change states i.e. ice at 0° C to water at 0°C.
3. Density or specific gravity is highest at 4°C (in liquid state).
4. High surface tension and cohesion which acts as a barrier to some organisms and supports a diverse community on the surface.

5. Light penetration is limited and varies with amount of dissolved solids present.

Because of its high solvent power, water is used in industry as a solvent or media in which many reactions or separations are done. Power companies utilize water to cool generators since it can absorb large amounts of waste heat with a minimal raise in temperature. Water is the only naturally occuring substance that has its highest density in the liquid state. If the ice did not float it would have profound effects on the ecosystem and aquatic life probably wouldn't have developed to today's form. Introduction of organic compounds to water will lower the surface tension which can change the community structure in the ecosystem.

Our fresh water supply is not unlimited as the following breakdown of the biospheres water will show. 97.1% - Oceans, 2.24% - polar ice caps or glaciers, .308% - usable ground water, .008% -fresh surface water. Less than .5% is available to meet all our water demands. We must change our concept of water usage to insure the continued use of this precious resource. In many parts of the world today water shortages exist or are imminent as comsumption of ground water exceeds recharge rate. Contamination by man is another way we limit usable water. Nature does release some contaminants into the environment but man is the major source of water pollution.

Pollution is defined as any impairment of a resource (any part of the biogeochemical cycle) for any of its beneficial uses, actual or potential, by man caused changes in resource quality. Pollution is divided in two categories point sources (a specific point of discharge) and no point sources (erosion, agricultural runoff, and acid rain are some examples). Different controls must be implemented for each catagory.

In the US there are two laws pertaining to water usage. In the eastern states riparian rights are practiced - any land owner whose property touches the water has priority and no one else can interfere with his use but water rights can be lost if not exercised.

Because of the degradation of the US's waterways the 1972 Federal Water Pollution Control Act became law. The primary goal is to restore and maintain the chemical, physical and biological integrity of the Nations waters. It is the EPA's goal that by 1983 the quality of all waters will be suitable for recreation, fish and wildlife. By 1985 any discharge of pollution which will degrade our waterways will end.

Two programs have been implemented to achieve these goals: the permit program and federal grants to construct public treatment plants. The permit program will restrict discharges from point sources and provide funds for programs or research to help eliminate acid mine runoff and other nonpoint sources.

Every point source must obtain a permit to discharge waste into water. The permits will contain schedules to reduce discharges over a specific time period so as not to cause an economic impasse. Sources must monitor and report their discharges on a regular basis. Violators are fined, shut down, or made to modify the process to comply with standards. Where toxic contaminants are concerned economic feasibility or available technology is not a legal bypass for discharges. No toxic materials may be discharged under any condition.

The permit system operates on three levels: federal which is controlled by the EPA, state, and local. The EPA set up ambiant H_2O quality standards and develops procedures used in controlling emissions. The state is responsible for implementing the permit system so that maximum daily discharges remain below levels set by the EPA. At the local level planning and management of sources and wastes must be directed by the community as a whole.

Presently, all industries must meet minimum compliance, but by 1983 discharges will be based on the best control and treatment measures that are economically capable of being achieved. All new sources must be designed to minimize discharges to as high a degree as is economically feasible.

and other information for the parameters. Using these sheets have the students interpret and discuss the results. Have them compare this site with others or the same one done at a different time. Stress how field ecologists would use this kit and standards to help them in determining the suitability of the habitat for fish and wildlife. They will supplement the kit with laboratory work if the results merit it.

Free acidity will be 0 in natural systems, industry and acid mine runoff would give positive results and indicate the presence of strong acids.

Total acidity measures amount of carbonic, stannic and other weak acids which don't dissociate at pH's below 8. It is used in conjunction with alkalinity to measure the buffer capacity of the water.

Alkalinity: phenophthalein - OH - ions (strong bases, should be 0 in natural systems)

Brom Creson Green - Methyl Red - HCO_3 and CO_3 (used to measure buffering capacity)

pH - Explain colimetric method of this test. Make sure every one understands the scale (use familiar items such as gastric juices-2 lemon juice - 3, tomato juice - 4, rain - 6, distilled water - 7, blood 7-8, baking soda (HCO_3) - 9, soap - 10, ammonia - 12, chlorox, 14).

Also discuss buffer system, eutrophication, nutrient regeneration, aerobic vs. anaerobic conditions, $FeSO_4$, and thermal pollution in connection with the tests.

The following questions may be helpful.

1. What sources might be responsible for the contaminants?
2. Are there any visible signs that the ecosystem is degraded?

4. (cont)
   hardness, buffer, eutrophication, BOD (biological Oxygen demand), limiting factor, and ambient levels.
5. References: Quality Criteria for Water, EPA, 1976 (Law Library TD 370, V467.

   Teaching Water Conservation, Illinois State Water Survey, Il Office of Education.

   Quality of Near-Surface Water's in Southern Illinois, Richard W. Davis (library under water)

   Citizen's Guide to Clean Water Planning in Illinois, Illinois EPA, 1977

B. Directions for Actual Learning Activity

1. Focus - Sit students at learning site. Introduce the properties of water using visual examples (dissolve a variety of substances in the water, look at water striders and use small plastic tube to show surface tension, a column of H_2O to show transmission properties). Discuss availability of usable fresh water and its degradation through man's activities. Talk about laws pertaining to water quality emphasizing how it affects individuals and industries at the local level.
2. The activity - Explain the general procedures used in the test procedures. Emphasize exactness, stressing careful mixing, holding the eye dropper vertically and noting the first point a color change occurs using a white background. Tell participants to convert results to mg/l or ppm. Use low range for acidity and alkalinity tests. If time permits have students run more than one test.
3. Synthesizing strategy - Time 30 minutes.

   After tests have been completed pass out sheets giving standards

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The Hach fish and wildlife testing kit does not test for Coliform. This parameter is given highest priority in determining the drinkability of public water supplies. Coliform is a bacteria found in the intestinal tract of most higher animals. If found in a natural body of water it is a good indicator that disease agents may be present. In public water supplies no fecal coliform can be present and between 240 & 2400 fecal coliform/100 ml, depending on the state, are the limits for swimming.

Natural systems have "built-in" mechanisms which can handle low quantities of some contaminants. Bacteria, fungi and other organisms can breakdown organic matter and some toxic compounds without degrading the environment. It is only when the system is overloaded that problems occur.

THE ACTIVITY:

A. Information

1. Learning site: any body of water or waste discharge point. If time permits test 2 different sites or have data collected earlier from different sources.
2. Materials: Hach Water quality kit (including Nitrate and phosphate cube kit), thermometer, 4 test tubes with 5.83 ml mark, sample and waste water containers, data sheet and handout to interpret results, pen and pencils.
3. Preparation by instructor: Run through each test in advance noting which steps may cause problems. All equipment should be cleaned beforehand to save time. It is imperative that you understand pertinent information about the parameters that you are testing and can explain it in layman's language. The students will know if you are not prepared.
4. Critical Vocabulary: specific heat, density, solvent, surface tension, pollution, coliform bacteria, titration, pH, acidity, alkalinity,

3. How might the system be cleaned up?

4. Could Eutrophication be a natural process? How do man made contaminants effect the process.

5. In the Adirondack mountains in NY there exists a problem of acidification of small ponds and lakes to the point of killing the organisms. How is this caused? What type of legislation or control is necessary to correct this situation?

6. What causes dO_2concentrations to drop to low levels in water? What type of organisms are more tolerant of low dO_2conditions? How could these organisms be used in determining the water quality?

7. Name 5 ways YOU could reduce water pollution.

By Jerry Culen

FISH MANAGEMENT IN FARM PONDS

GRADE LEVEL:	SUBORDINATE EE GOAL: LEVEL IV ACTION SKILLS TRAINING AND APPLICATION A, B, C, D.
7-12	

MAJOR INSTRUCTIONAL GOAL:

To familiarize students with the proper methods and techniques utilized by fisheries biologists to manage and maintain fish populations in a pond or lake.

ASSOCIATED CONCEPTS:

A. Populations
B. Predator/Prey Relationships
C. Sustained Yield
D. Ecomanagement
E. Fisheries Management

SKILLS:

A. Collecting
B. Identification
C. Interpreting Data
D. Predicting
E. Problem Solving

BEHAVIORAL OBJECTIVES:

Upon completion of this activity, the students will be able to...

1...identify four management techniques that are essential for the proper maintenance and utilization of the fishery within a pond or lake.
2...correctly use a seine to collect fish in a pond for the purpose of gathering information pertinent to managing that aquatic system.
3...record data gathered during a fish-collecting field trip and interpret that information as it pertains to the fish populations of that lake or pond. Also the receiver should be able to state the importance of the data collected to fish management practices.
4...identify predator and prey fish species commonly stocked in Illinois ponds and lakes and describe how these species theoretically interact to maintain proper population levels within these aquatic communities.
5...explain why after several years of fishing pressure

it may become necessary to manipulate the fish populations in order to maintain a desirable fishing pond or lake.

6...explain what is meant by sustained yield as it pertains to fish management of a pond of lake.

7...make decisions and recommendations pertaining to maintaining a fishery within that pond or lake.

8...explain how fish management practices represent an example of ecomanagement.

BACKGROUND INFORMATION:

Although a single pond may not look like much, these little lakes add up to a lot of water (over 49,000 acres in Illinois alone). Each of these ponds has the potential to provide good fishing, but the majority of these are not managed for fishing. Good fishing is the result of proper management and this involves more than just stocking fish in a pond. This activity is designed to introduce students to proper fisheries management techniques and should give them the opportunity to make decisions concerning proper pond management.

Fish populations are not just determined by the size of the pond but by a variety of factors, including soil fertility, water depth, turbidity, temperature, and water quality. Therefore, the pond location, its construction, and care are very important. Life histories of these species must be known so that management practices can focus on the basic needs of these fish. Several species are generally used to stock Illinois ponds: Largemouth Bass, Bluegill, Redear Sunfish, and Channel Catfish. These species are adapted to Illinois' climate and water and usually can be managed under a single program. For further information on life histories, refer to Pond Fish and Fishing in Illinois, pp 10-16.

Before a pond is stocked it should be sampled to see if other fish are present. Many times in older ponds undesirable fish may have been introduced or an imbalance in fish populations has occurred; stocking of additional fish in this type of pond will not improve the fishery. In this situation fish should be removed by draining the pond or chemical treatment and then restocked with desirable species in correct numbers. The stocking of correct numbers and sizes is also very important to the eventual fishery. The recommended rate for fingerling largemouth bass in Southern Illinois ponds is 50-100 fish per surface acre. These stocking rates would depend upon the fertility of the pond and its watershed.

(Refer to stocking charts in Pond Fish and Fishing in Illinois, p. 23.)

After the initial stocking, proper management techniques are essential to maintain catchable populations. (Refer to the Fish Harvesting Guide provided and also to Pond Fish and Fishing in Illinois, pp 24-39 for more information on management techniques.)

Improper harvesting or management practices may result in an imbalance in predator or prey species. This will usually occur several years after the first stocking and it may become necessary to test a pond's fish population. Dr. H.S. Swingle of Alabama has developed a method of sampling fish populations in ponds that will determine the condition of that fishery. The test should be made during the summer when a pond is two years old or older and has been stocked with large-mouth bass and bluegills. The following activity describes Swingle's technique and recommended management if the pond is found to be out of balance.

THE ACTIVITY:

A. Information

1. Learning Site - Any farm pond that is easily seined and will produce a good sample of fish. (Should contain largemouth bass and bluegills.)

2. Materials - 1 or 2 20' seines, several 1 quart glass jars, 3 or 4 dip nets, a pencil and paper and 2 pairs of chest waders (if water is cold).

3. Preparation - Check nets for tears. Sample the pond to become familiar with the organisms that are found. Using both the seine and dip nets, construct some food chains that include fish at one of the trophic levels. Information concerning size, depth, age, water quality, fish stocks, and the watershed of the pond would be helpful for the introduction.

4. Vocabulary - Sustained yield, population, turbidity, predators, prey food chain, fertility community.

5. References, tips, hints, worksheet, or handouts:

a. Pond Fish and Fishing in Illinois, Department of Conservation, A.C. Lopinot.
b. Small Lakes and Ponds: Their Construction and Care, Department of Conservation Fishery Bulletin #3.
c. Aquatic Plants of Illinois, Glen S. Winteringer, Illinois State Museum.
d. Fresh Water Invertebrates of the U.S., Pennak.
e. Management of Lakes and Ponds, George W. Bennett.

This is a difficult activity to perform with any type of group, therefore the instructor should carefully read the background information and utilize the references given. Preparation for this activity will take a considerable amount of time, so start early and be prepared to answer questions and identify various aquatic organisms. Charts found in references:

Fish Harvesting Guide
Fish Stocking Charts
Swingle's Pond Analysis

B. Directions for the Learning Activity

1. Focus - Take the students to the pond to be sampled. Introduce them to the idea of fisheries management and explain that they will be sampling the pond to determine fish population numbers and sizes in order to make some management decisions when they have finished. Present some factors that play a role in determining how many pounds of fish a pond might hold. Then point out some ideas on the construction and care of a pond, emphasizing the importance of all these factors in the eventual fishery. Begin to introduce some fish management techniques that can be utilized to maintain a proper balance within a pond, such as proper stocking and harvesting rate, vegetation control, brush removal, fertilization, and trapping. Point out improper management techniques and how these will effect fish populations. Distribute worksheet and explain Swingle's method of sampling. Designate an individual to record all data collected. Show the participants how to use the seine correctly and caution them about the danger when wearing waders.

2. The Activity - Select a spot that you would like to seine and fill the quart jars with water. On the first sample, record all data on the worksheet and place several bass, bluegill and other species of fish in the quart jars. Quickly return the remainder of

the fish by turning the net over in the water. (Remember to record the number and size of all fish collected. Try to handle the fish as little as possible because handling may harm them.)

Make sure everyone gets to see the largemouth bass, bluegills and other fish that you have placed in the jars. At this time, explain the predator/prey relationship that exists between these species and indicate the importance of such a relationship to the balance of the populations.

Three hauls with the minnow seine should provide enough information to determine the condition of the fish population. Some aquatic insects should appear in your samples: be prepared to identify them and point out how they might fit into the food chain of the pond. Plants will also be collected in the samplings; identify them using Aquatic Plants of Illinois and question students on the significance of plants on fish populations. Dip nets may also be used to collect invertebrates and plants.

After the last haul, shake the net thoroughly to remove debris and excess water, bundle and return to nature center for drying.

Gather the students together and have the recorder call off the results so that everyone may record the data.

3. Synthesizing Strategy - Utilizing the worksheets, have the students determine what types of populations exist in the pond and ask them to indicate what management practices might be undertaken to balance or maintain the fish populations. If the samplings indicate desirable fish populations, ask the students to indicate why this might have happened. Provide data on fish populations other than that collected and ask students to recommend management practices that would produce a better fishery.

Discuss the following:

1. How fishing pressure might alter the fish populations and indicate management practices necessary to re-establish a proper balance.

2. Discuss the term sustained yield and ask students to describe some of the management techniques necessary to maintain a desirable fish population.
3. Discuss the term ecomanagement and how it relates to man's management of ponds.
4. Preview the words turbidity and fertility and discuss these factors in relation to the number of fish a pond can support.
5. Ask the students to identify food chains that exist in this aquatic ecosystem.
6. Discuss the various species of fish that are undesirable in ponds and indicate why they are undesirable.

If enough time remains and the pond is out of balance, take remedial action. Before you take any action, make sure the results are valid. The pond analysis sheet is meant to be used only during the spring and fall, but the results might not reflect the actual balance existion in the pond.

4. Suggestions on Time and Problems- This activity will take longer than one hour.

Several problems may arise during the course of this activity:

1. Be prepared to assist the individuals who are seining so that good results can be obtained.

2. Use caution when using chestwaders and be prepared to assist if an individual trips or sinks.

3. No fish in the seine at all may indicate that the fish have gone deeper and you probably won't get a good sample or that your method of sampling is allowing the fish to escape.

4. Be prepared! Students will have many questions and will look to you for answers.

ACTIVITY:

Garbonzo Bugs

Major Instructional Goal: To Help students understand the concept of population density with particular emphasis on its effect on habitat, health, and predator-prey relationships.

Associated Concepts:

A. Birth - Death Rate
B. Immigration - Emigration
C. Habitat
D. Predator-Prey Fluctuations
E. Carrying Capacity

Behavioral Objectives: Upon completion of this activity the participants will be able to:

1. Define population in its ecological context.
2. Name the four factors affecting population level.
3. Define habitat.
4. Explain what is meant by an animal's habitat requirements, and give examples of some requirements for deer and ducks.
5. Define population density.
6. Describe the effects of a high density on the population and the habitat.
7. Explain the relationship between predation and the density of the prey population.
8. Define carrying capacity.
9. Describe the result of exceeding carrying capacity.
10. Explain how carrying capacity can be increased through management.
11. Give examples of how humans manage their own carrying capacity.

Background Information: For T.O.N. Instructor

A wildlife population is a group of animals of the same species. The number of individuals in a particular population is determined by four factors: 1) birth rate 2) death rate 3) immigration 4) emigration. Habitat is the place where a wild animal lives. It provides everything the animal needs to survive, most importantly food and shelter. The number of individuals of a given species in a defined area is called the density of that population. When the density is high, food and shelter may not be readily available and disease will spread more easily and more quickly. As the number of individuals in the prey population increases, so will the number of predators. Carrying capacity is the number of individuals that a habitat can support in a healthy state for an indefinite period of time. If this level is exceeded, serious damage to the habitat may result. Without sufficient food or cover, the wildlife population will decrease drastically. Proper management has increased the carrying capacity for many game species. Techniques such as food plantings and creating small clearings have worked well in the past.

The Activity:

A. Information

1. Learning Site - any open, grassy area approximately thirty feet square will do.

2. Materials - two or three pounds of garbonzo beans, one blackboard or notebook, one yardstick, four stakes or markers, one wire quadrat.

3. Preparation by Instructor - Lay out a study site in an open grassy area. The site should be about twenty square feet (the numbers should be kept simple for ease of calculation). Distribute the beans evenly throughout the site. Construct a wire quadrat from a coat hanger, this should be one square foot.

4. Critical Vocabulary - Population, Population density, Birth rate, Death rate, Immigration, Emigration, Habitat, Predation, Carrying capacity, Management

5. References -
   a. Bean Bugs - an OBIS activity
   b. Ecology and Field Biology - Smith, N.Y. Harper and Row, Second edition, 1974.

B. Directions for the Activity

1. Focus - Time 5 minutes

   Guide the students to the learning site. Along the way you may wish to introduce the site as a wildlife refuge which contains a rare and valuable animal. Explain that the manager must know how many animals there are in order to best take care of them. Because it would be too hard to count every one, a simpler method will be used. Once at the site, define what "population" means in regard to wildlife.

2. The Activity - Time 20 minutes

   Random samples are taken by throwing the quadrat into the study site and counting the number of beans lying within. Allow each student to throw the quadrat once. Record each trial on the data board. Average the number of beans from the trials. Measure the study site and calculate the number of quadrats it contains. Expand the data for the entire area by multiplying the average number of beans per quadrat by the number of quadrats in the study area.

3. Synthesizing Strategy - Time 20-30- minutes.

Gather the students into a group and discuss the following questions:

A. What does "population" mean?
B. How could the number of animals in the population change?
C. What does "habitat" mean?
D. What does the habitat provide for the animal? (Can you name some requirements of deer? ducks?)
E. What does "population density" mean?
F. What can happen to the population if the density becomes very high?
G. What effect will a very high population density have on the habitat?
H. What is a predator? Prey?
I. Does a predator have an effect on the population density of the prey and vice versa? How?
J. What does "carrying capacity" mean?
K. What effect will exceeding carrying capacity have on the habitat and the animals living there?
L. Define "Wildlife management".
M. How do humans increase the ability of the earth to support themselves?
N. What are the consequences of these actions?

SUCCESSION IN A FOREST COMMUNITY

MAJOR INSTRUCTIONAL GOAL:

To help the students conceptualize forest succession and obtain knowledge about quantitative data collection used by field biologist.

ASSOCIATED CONCIPTS:

A. Quadrat
B. Understory
C. Understory
D. Seedlings
E. Seral stages
F. Climax community
G. Homeostasis
H. Light tolerant species
I. Shade tolerant species

SKILLS:

A. Data collection
B. Identification using a dichotomous key
C. Graphically representing data
D. Data analysis
E. Prediction
F. Concept synthesis

BEHAVIORAL OBJECTIVES:

1....demonstrate their ability to use a dichotomous key by identifying at least two trees with it.

2....differentiate between the canopy, understory, and seedling layers of a forest.

3....analyze sets of data for similarities and differences between sets.

4....extrapolate, using the quadrat data, what the old field site will look like 25 years, 50 years, 100 years from now if it is left undisturbed.

5....name four seral stages in their respective order found in secondary succession.

6....describe how an early seral stage modifies its environment and thus causes its own replacement by the next seral stage.

7....classify different tree species as either light or shade tolerant and state whether they would be found in the pioneer or mature forest stage.

8....define climax community and name the climax community that would be generally found in Southern Illinois.

(iris, spike rush, sedge)--shrub stage (buttonbush) --tree stage (cottonwood, black willow, sycamore).

II. Generalized succession of rock bluff in Southern Illinois: Lichen stage (crustose, foliose, and fruticose lichens)--moss stage (blsck, haircap and twisted mosses--Herbaceous stage (wire grass, sundrops, St. John's-wort)--shrub stage (farkleberry catbriar, buckbrush)--tree stage (red cedar, post oak, blackjace oak.

III. Probable Secondary Succession in Southern Illinois: Annual (weed stage) (annual ragweed, biennial primrose, annual panic grass)-- perennial weed stage (broomsedge, goldenrod, bluegrass) --Shrub stage (poison ivy, sumac, dewberry, black-berry)--pioneer tree stage--(persimmon, sassafras, black cherry, winged elm, black locust)--later tree stage (red, white and black oak, hickories, maples, and beech).

Not all sites will ever reach the final stage, or mesic condition, of succession. Succession can stop at any stage. A stone bluff with a very steep dropoff will probably never progress past the lichen and moss stages. These stages will be the final stages of succession for that particular site.

Ecologists collect data about succession in different communities in different ways, one way is the use of quadrats. A quadrat is marking out a precise area with clothesline or twine and stakes. On a prairie where the plants grow very close together quadrats may only enclose 1 square meter. In the forest 100 square meters is the commonly used area.

The soil moisture increases since the drying effect of the sun is not as intense. Oaks, hickories, and maples (to name a few) will start growing in the shade of the pioneer trees and shrubs. Eventually these trees will become the canopy and shade out and eliminate the pioneer trees. The amount of light and mositure determine what types of plants will be found in the community.

No matter if the initial - community started out being wet or dry it is theorized that there is a progression for both initial communities to a mesic (intermediate on the moisture gradient) condition and this final or climax community is an internally stable (homeostatic), self perpetuating community. It is in dynamic equilibrium with the registics net community production is low; usually, but now always, more species diversity, increased biochemical diversity; large storage of organic matter; mineral cycles are closed; life cycles are long and complex; size of the organisms are large and fewer numbers of offsprings having a good chance of survival as opposed to the condition found in early successional stages of many offspring with only a few surviving.

Succession is characterized by:

A. Predictability

B. Proceeding from simple to more complex (usually)

C. Moves towards a climax community

D. Occuring on a space/time continuum.

E. Change is orderly.

Examples of Succession:

I. Generalized succession of aquatic systems in Southern Illinois: Submerged stage (waterweed, hornwort)--floating leaf stage (water fern, duckweek, yellow and white pond lily)--amphibious stage (cattail, bur-reed, water lotus, bulreed)--wet meadow stage

BACKGROUND INFORMATION:

Most communities are not permanent but are hemeostatic during their existence. There are progressive changes in the species structure, organic structure, and energy flow. This change is brought about by a modification of the physical environment by the organisms themselves or by some external control such as salt spray from an ocean or periodic occurances of fire. This progressive change is known as succession.

There are two kinds of succession - primary and secondary. Primary succession begins on terrestrial or aquatic bedrock surfaces that are altered little or not at all. Examples: rock bluffs or sand dunes. Secondary succession begins on surfaces that have already been altered by organisms (e.g.soil formation) that have been growing on the particular site. Examples: plowed farmlands, cut or burned forest.

Within succession various stages can be discerned by its community composition. These are called seral stages and occur in the same order in succession. The first seral stage in secondary succession is a newly abandoned field. Generalists who can withstand harsh conditions and have a rapid growth rate invade the field. Grasses and other annuals are the first to become established and do very well in disturbed soil which is low in moisture and has large temperature fluctuations. The perennials can be found a few years later. The conditions are slowly modified as the ground cover becomes established and the organic matter content of the soil increases. The soil will retain more moisture and the temperature fluctuations will not be quite as extreme. This allows shrubs and pioneer trees to start growing in the field. These seedlings need the high sunlight in order to grow. Eventually they will create enough shade on the ground which modifies the abiotic conditions even more.

The quadrat worksheet is used to record the location of trees within thw quadrat and what kind they are. From this record the total population found in the quadrat is known and can be used to draw conclusions about the forest's characteristics. By using several quadrats a more accurate picture is obtained.

It is often times helpful to use a couple of work sheet for each quadrat. On one worksheet a map of the canopy trees is shown, on a second understory trees are mapped, on a thrid the seedlings are recorded. This aids the ecologist in predicting what the forest will look like in the future. If the canopy and understory consists of different species it is likely that the understory species will replace the canopy trees when they die.

THE ACTIVITY.

A. Information

1. Learning site- An area where an old growth forest is in close proximity to a Pioneer tree/shrub community. It it also helpful but not essential that earlier stages of succession may be found in the area so that a comparison of abiotic factors and dominant plants found in each area may be made.
2. Materials - String to mark off quadrats, 8 stakes, tape measure, forest trees of Illinois or other field guides, quadrat data sheets, pencils, soil thermometer (optional), and chalkboard and chalk.
3. Preparation by Instructor - In the learning site stake out a 10m x 10m area within the old growth forest area and a 10m x 10m quadrat in the Pioneer community. You should

3. examine the quadrats to make sure that it is a representative sample of both communities. Identify any unknown trees found within the quadrats at least to genus.

4. Critical Vocabulary - quadrat, canopy, understory, seedlings, pioneer community, seral stages, abiotic, climax community.

5. References: Ecology and Field Biology, R. Smith. N Y Harper and Row, 2nd edition, 1974; Teaching Environmental Education, H.R. Hungerford and R.B. Peyton. J. Weston Walch, Publisher, 1976.

B. Directions for Actual Learning Activity

1. Focus: Take students to the learning site. Ask them what this area looked like before the pioneers settled the area. Why did they clear the land? (growing crops, grazing animals, fuel, building materials, and for roads, houses,etc.) Discuss what happens to fields after they are abandoned. If earlier stages of succession are available, walk through these areas noting dominant plants and abiotic conditions that are found there.

   Explain the method of using quadrats as a sampling tool. Divide the group in half. The first group will work in the Pioneer community quadrat mapping out the canopy trees on one worksheet and understroy trees on a second worksheet. The second group will work in the old forest quadrat and will map the canopy, understory, and seedling trees on three worksheets.

Go through the quadrat. Worksheets with the student and make sure they understand how to fill them out. If you use the field guides make sure the students know how to use them.

2. Activity: The students will now complete the worksheets in the two quadrats. The teacher should move between the two groups to make sure they can identify all the trees. You may want to go over the trees present in the two quadrats before they start recording data. After they map out the trees have them figure out the frequencies and percentages. If soil thermometers are available record the temperatures in both quadrants.

3. Synthesis: This part of the activity may be done in the classroom. Record the species, frequency, and percents for each worksheet on the board. Use this data to show how the pioneer community will eventually become an old growth forest if left undisturbed. Bring out the point that the pioneer community will change the abiotic conditions that originally favored itself and thus allow the old forest species to appear. The pioneer species are classified as light tolerant species since they need a lot of sunlight. Some examples are sumac, persimmon, winged elm, sassafras, wild plum, black cherry and tulip poplar. The old forest species are shade tolerant. Their seedlings need shade in order to grow. Examples of these species include oaks, hickories, maples, dogwood, paw paw and beech.

The following questions can be used to guide the students through the synthesis.

1. If you looked at a field in which cultivation was discontinued a few years ago, what might be some reasons why so few seedlings are present.
2. Compare the understory and canopy quadrats between the pioneer and old forest communities. Are there more trees in the understory or in the canopy at any given time? Hypothesize as to why this is the case.
3. Using the quadrat worksheets, answer the following:
   a. List the tree species that disappeared from the understory between the two stages.
   b. List the tree species that appeared in the understory two stages.
   c. What differences in abiotic factors exist in the understory between the two communities. How might these conditions affect the seedlings that germinate and start growing in both communities.
4. List the tree species that are found in the canopy of the pioneer community. Using the understory data for the pioneer quadrat perdict which trees listed above will not be found in the canopy 50 years later. What might be the reason that these trees will not be found in the canopy.
5. Do you think that there would be a difference in temperature, both air and soil, between the two communities during the summer? What might cause

this difference and how would it affect the ecosystem.

6. A climax forest is a community in which succession has stopped. Two common climax communities found in Southern Illinois are the ties the dominant species are reflected in the name of the forest. What climax forest do you predict would exist in this area if left undisturbed? Give your reasons for your choice.
7. What are the species you would expect to be found in the climax community. Give your reasons why some species will be eliminated in the climax community.
8. Using the data collected and observations of the various seral stages. List the events or changes that take place in secondary succession from cultivation to the climax community.

Suggestions and Problems

It is important that the quadrats chosen represent the entire community you are examining. The pioneer-shrub community quadrat should include some oaks or hickories in the understory to help facilitate the transition of this community into the old forest. Oaks and other species found in the later stages will be found in the pioneer community if it is old enough. Therefore, care should be taken in choosing the right quadrat. If you have time discuss the animals that will inhabit each seral stage and what their requirements are. It may require some time to synthesize the data collected. One possibility is to do the worksheets one day and have the students tabulate the frequencies and percents that night. Oftentimes the students will not be able to synthesize the changes in community structure by discussing what abiotic conditions are required by the various light tolerant and shade tolerant species and how these conditions are modified by the community.

GOOBER ETUS

GRADE LEVEL:

2-8

SUBORDINATE E.E. GOAL LEVEL I
ECOLOGICAL FOUNDATIONS A, B, F

MAJOR INSTRUCTIONAL GOAL:

To help students understand the relationships that exist between predator and prey populations which keep them in a homeostatic state.

ASSOCIATED CONCEPTS:

A. Interdependence
B. Populations
C. Habitat
D. Predator-Prey Relationships
E. Adaptation
F. Environmental Influence
G. Extinction
H. Homeostasis

SKILLS:

A. Observation
B. Simulation
C. Data Collection
D. Graphing
E. Analysis of data
F. Synthesizing
G. Prediction

BEHAVIORAL OBJECTIVES:

Upon completion of this activity the participants will be able to...

1...name 3 factors that help to protect the prey species from its predators.
2...predict what would happen to the Goober etus population if the students continued to prey on them over a long period of time.
3...give 2 examples of how a population would become extinct.
4...describe orally how predator-prey relationships serve as examples of interaction in communities of plants and animals.
5...construct a graph depicting change in predator-prey population levels over a period of time and be able to explain the reasons for the shape of the graph.
6...define homeostasis and state how the predator-prey populations are affected by it.

BACKGROUND INFORMATION:

Given time, a population generally reaches a balance of numbers based largely on the carrying capacity of the environment, relationships within the population and outside forces. One force operating outside the population may be predation, in which the members of the prey population are fed upon by predators. Usually the population size of the prey is affected by the population size of the predator in an adverse relationship. Under controlled laboratory conditions both predator and prey may become extinct. In natural systems extinction caused by predation is much rarer. Extinction of an organism is complicated by the fact that both predator and prey are part of a complex food web.

Many factors such as relative adaptability of both predator and prey, the length of time they have been associated, and the stability of their environment play important roles in their population trends. The long range trend of such predator-prey relationships would be a system of built in checks and balances between the two populations and the myriad of their relationships within their ecosystem. For example, at high prey densities, the predators are quickly satiated. But at low levels, they expend large amounts of energy to capture a few individuals, so predators shift to other prey species. Thus the survival rate does not usually approach zero, some prey always survive. This equilibrium is called homeostasis. Both of these tendencies should be observable in the activity. Any extension of the activity. (i.e., allowing the participants to continue hunting) would cause an imbalance among the predators within the predator-prey relationship. However, predictions may be made based on these conditions.

One component of such a system of checks and balances is natural selection, the mechanism by which an organism evolves while adapting to its environment. One feature of natural selection is the development of color or color patterns or the means of changing so that the organism's color blends with its environment. This color may act as camouflage, protecting the organism from predators and provide the organism with a better chance for survival. Within a species, this coloration and/or the biological mechanisms associated with it may be passed on to following generations. Thus a species may develop desirable survival traits (i.e., protective coloration) as an adaptation to its environment.

This activity simulates many of the relationships that exist between predator and prey populations in nature. Successful predation initially leads to a smaller prey population. However, it will eventually produce a smaller predator population as well,which will replenish over time as population of prey begins to grow. Thus the cycle is repeated and the size of both populations are maintained between an upper and lower limit.

THE ACTIVITY.

A. Information

1. Learning Site - any edge community where small organisms are likely to find a food source, home, and place to hide from the predators.

2. Materials - Peanuts (100); graph, paper, a black board.

3. Preparation by the instructor - be familiar with the edge communities in the area you will be working in. Choose an area for accessibility, colors and lack of poisonous plants. Plant the peanuts for the activity before the children arrive. In the case of two back-to-back activities in the same day, make sure that the sets of peanuts are far enough apart so that students will not discover the second group of peanuts. Choose two separate sites with at least 30 feet between them to prevent straying from one site to the other. This will

prevent a rush or mix up between periods.

4. Critical Vocabulary: Predator, Prey, Population, Community, Protective coloration, Habitat, Adaptation, Extinction.

5. References: Tips, Hints, Worksheets and Handouts:

   1. Odum, Ecology (A Modern Biology Series)
   2. Gilbert, N., (Frazer, S., D. Gutierez, A.P., Jones R.E.) Ecological Relationships.
   3. Mimicry by Wolfgang Wickler
   4. Camouflage: A CWES activity (in the activity file)
   5. Sticklers: AN OBIS activity (in the activity file)

B. Directions for the Actual Learning Activity

1. Focus - You have chosen the site and planted the Goober etus population. Rush back to the area where students and instructors gather, excited about "discovering" a population of rare "Goober Etus." This excitement should interest the students. No time should be lost in getting the group moving towards the activity site. On the way to the site the following must be accomplished: Describe the size of Goober Etus, its color and exo-skeleton. A comparison of the Goober Etus to an insect is a good way to bring out descriptive characteristics. Describe the habitat it's found in. Once these are clear, emphasize and model the stalking for prey. The instructor must model by quietly scanning the type of community identified as Goober Etus habitat.

2. The Activity - Stop the students within 10 feet of the activity site, emphasizing silence. Explain how noise or movement may scatter the herd. Pretend to listen closely to a similar habitat, quickly glancing at the selected site. Walk quietly towards the site. Beckon for students to follow. Tell them that this is where you saw them--and that the herd has reappeared. Review the characteristics and then send the students into the site in search of Goober Etus.

   Allot one minute for the idea of the simulation to be caught. Hints may be given. Ask the students to stop searching at the end of that time. Tell them to stand up and come out. Based upon their experience, describe the terms, predator, prey and population. Record the number of Goober Etus caught and the number of students finding them on paper (or a blackboard if one is handy). Ask them what happens to predatory animals that don't find food (they starve to death). Those who starve must sit out. When the group of surviving predators is sent back in a second time, suggest to the starved predators that they should watch what surviving predators must do to find Goober Etus. Repeat the search process 3 or 4 more times for a duration of about 1/2 minute, eliminating unsuccessful predators each time. After the predator(s) enter for the last time, ask the students to take a seat.

3. Synthesizing Strategy - Part I: This part of the strategy utilizes math skills and graphing instruction to assist students in plotting the recorded data from the activity. It will usually represent changes in population. Ask the students why graphs are often used when studying the data collected from a study. Discuss the uses of graphs, used in 1) showing relationships between 2 variables, 2) estimating numbers between data points and 3) predicting the future. After they understand these reasons, have some volunteers construct the graph. One axis will represent time while the other one the number of predators and prey that are alive. Have the students place both graphs on the same chart so comparisons between the two populations are easily seen. Younger students may not have the skills or concepts needed to construct or understand a graph. If this is the case, have the students place the peanuts they caught after each time period in a separate pile. By looking at the size of the piles the students should be able to figure out the relationships that exist between predator and prey populations.

   Part II: Discuss the following questions, eliciting answers based on experience and observations.

   1) did the colors of Goober Etus blend with its environment? If so, how? Could this color(s) be used to protect it? Which colors would be favored to survive then?

   2) What is happening to the predator and prey population? What are 3 factors to account for more prey being caught in the beginning than the end? (more prey, more predators, and easier to find)

   3) Do you think that the Goober Etus population will become extinct? Why or why not? Will the predator population become extinct?

   4) In a real situation, say wolves and deer, why do both populations continue to co-exist? How does the deer population control the wolf population and vise versa?

   5) What are two reasons in which populations do become extinct? (habitat destruction, market hunting by man, introduction of new blight or disease, and introduction of new species which will outcompete the original one for its niche.)

Suggestions on Time and Problems

The total activity can be completed within one hour. The activity itself however is relatively short. Thus the focus and site choice are critical in helping set the activity tone. You might want to hide the peanuts better for older students. During search times, clarify the key words and concepts as well as suggest predator observation and nearby observation of organisms. The number of time periods is relative, depending upon population sizes and time.

For the synthesis, select a site free from interruptions. Though a road works well, cars may easily interrupt the synthesis strategy. If this does happen, or if the group is restless, you may devise a quick physical activity to use some of their energy. Young students may have difficulty with the graphing strategy. It has been done with second graders successfully, but consult the teacher for assistance in deciding what they could successfully do. And lastly, if one or two tend to dominate the synthesis, actively ask silent students to participate through questions. But do not force them to do so.

AQUATIC SUCCESSION

GRADE LEVELS:

9-12

MAJOR INSTRUCTIONAL GOAL

To develop in receivers the knowledge that aquatic ecosystems undergo orderly changes towards the development of the climax community. These changes are the results of interactions between biotic and abiotic factors that occur within the watershed of the aquatic ecosystem.

ASSOCIATED CONCEPTS:

A. Community
B. Ecosystem
C. Eutrophication
D. Detritus
E. Stratification
F. Biomass
G. Diversity
H. Dynamic equilibrium

SKILLS:

A. Observation
B. Investigation
C. Data Collection & Recording
D. Synthesis

BEHAVIORAL OBJECTIVES:

Upon completion of this activity the student should be able to ...

1...identify 4 seral stages in pond succession and identify 2 dominant plants and 2 common animals found in each seral stage.

2...explain how each seral stage has modified its physical environment and determine the significance of this change in aquatic ecosystem as it undergoes succession.

3...identify 3 basic trends in the community structure of the aquatic ecosystem as it undergoes succession.

4...properly use a seine, plankton net, dip net and secchi disc.

BACKGROUND INFORMATION:

Ecological succession is the orderly and predictable replacement of one community by another community. During succession, a community modifies its physical environment and creates conditions which are unsuitable for its continued existence. Subsequently, a different group of species will eventually dominate the community. A climax community maintains an equilibrium with the physical environment. This equilibrium is called homeostasis. Each level of community development is referred to as a seral stage. The sum of all seral stages is defined as a sere. Pond succession is an example of hydrosere.

The study of a pond can reveal several stages in aquatic succession. If the pond is man-made and young, then we may observe a basin devoid of plants. Caddisfly larva often inhabit the barren bottoms of ponds. Plankton, however will eventually colonize the pond and larger aquatic organisms will feed on the plankton. The decomposition of the plankton and other deep-water organisms will create an organic layer on the bottom of the pond. (We refer to partially decomposed organisms as detritus.) The organic sediment functions as a substrate for submerged plants. The submerged plant stage is typified by algae, and pond weed. Dragon fly and may fly larva and small crustaceans inhabit the rooted submerged sediment functions as a substrate for submerged plants. The flora and fauna of the submerged plant stage all to the organic sediment in the pond. The increase in nutrients and depth of the organic sediment in the pond. The increase in nutrients and depth of the substrate allow floating plants to invade the pond. Creeping water primrose (Jussisas repens) and duckweed are two examples of floating plants. The leaves of the floating plants prevent light from reaching the bottom of the pond. Subsequently, the submerged plants can no longer survive. The leaves of the floating plants, however, create an additional situation for organisms to occur. Small amphibians and beetles frequently inhabit the pond's floating vegetation. decay of these larger organisms again adds to the pond's organic sediment. Due to the addition of sediment, the water level in the pond decreases and the floating-leaved plants can no longer survive the seasonal dry periods. Emergent plants, however, can tolerate low-water conditions. Heart-shaped water plantain (Alisma Subcordatum) cattails, sedges, Bulrush, blunt spikerush and the common Arrowhead (Sagiltoria latfolia) are common examples of emergent plants. The community dominated by the emergent plants provide more strata for animals to inhabit. Red-winged blackbirds and muskrats inhabit the emergent plant stage of pond succession. The emergent plants greatly add to the amount of organic matter in the pond. Due to the high level of decomposition in the older stages of pond development, the oxygen level of the water is low. Subsequently, only organisms which require a relatively low amount of oxygen can live in the pond. For example, Bullheads and sludge worms can tolerate water which is deficient in oxygen. The emergent plant stage of pond succession is known as a marsh. As the area's soil builds and drainage improves, meadow grasses will replace the emergent plants. If the area remains undisturbed pioneer trees will invade the meadow. Oftentimes Oak and Hickory seedlings, which can tolerate more shade and drier conditions, will replace them. In many parts of Southern Illinois, the Oak-Hickory Forest is the climax community in a hydrosere.

Eutrophication is the natural "aging" of a water body due to the addition of organic matter. Human activities, however, can accelerate the eutrophications of a water body. For example the addition of phosphates or sewage which stimulate algae growth, will increase the amount of organic matter in a pond. The introduction of a more organic matter to the water creates an increase in the level of decomposition and a decrease in the level of oxygen. Subsequently, only organisms with a relatively low demand for oxygen can inhabit the pond. As the pond ages it also fills in and will become warmer since there is less water, increasing the temperature also affects the community structure.

THE ACTIVITY:

A. Information:

1. Learning site- an area which includes two or more ponds at various seral stages in aquatic succession.

2. Materials - worksheet, seine, dip nets, plankton net, twenty foot length of rope, 10 liter buckey, white enamel pan, waders, microscopes, sample jars, magnifying glass, trowel, secchi disc, and identification keys (see references). A quantitative water quality kit is optional (should contain dO_2, hardness, phosphate, nitrate and pH).

   A plankton net may be made by expanding the top of a nylon with a wire hoop. The toe of the nylon should be removed. You should attach a piece of cotton around the bottom opening and a large test tube should be attached to the cotton material. This ensures the collection of an adequate amount of plankton to observe under a microscope by straining a large volume of water to pass through the net.

   It would be helpful if another teacher could assist you during the activity. This would allow you to have the students perform number of activities at once and also keep everyone involved in data collection.

3. Preparation by the instructor - The instructor must visit the sites and identify what seral stages are present. The instructor should become familiar with the dominant plants and animals in each seral stage. One should also study the operation of any unfamiliar equipment. For a more complete explanation of the use of a water quality kit see the activity entitled Water Quality.

4. Critical Vocabulary

    a. succession
    b. homeostasis
    c. seral stage
    d. hydrosere
    e. detritus
    f. eutrophication
    g. biomass
    h. stratification
    i. climax community

5. References -

Smith, Robert L Ecology and Field Biology, Harper and Row Publishers, N.Y. 1974.

Odum, Eugene, Ecology, Holt, Reinhart, and Winston, 1963.

Winterringer and Lopinot. Aquatic Plants of Illinois, Department of Conservation, Division of Fisheries, 1966.

Pennak, Robert. Fresh-Water Invertebrates of the U.S., the Ronald Press Company, N.Y. 1953,.

Aquatic Food Chains, Farm Pond Management, Water Quality - Touch of Nature Activities

B. Directions for the Actual Learning Activity

1. Focus;
   Before the students arrive at the site, the instructor should explain the process of succession. (The accompanying handout may clarify the dynamics of succession for students.) The instructor should define all terms which are basic to the conceptualization of aquatic succession. An introduction to succession should include the following points.

    a. Succession is the orderly and predictable replacement of our community by another community.
    b. During succession, a community modifies its physical environment and creates conditions which favor the establishment of a different community.
    c. Communities continue to replace each other until a climax community evolves.

The instructor should distribute worksheets and explain the items which appear on the handout. One should also locate the study site on a map for the students. Finally, the instructor should suggest that students form teams consisting of two people or more.

Once the class arrives at the site, the instructor can briefly explain the history of the area. One should also demonstrate the proper use of the equipment. Before students begin to collect data, they should identify the seral stages which are present at the site.

2. The Activity

In each seral stage the students should collect the following data.

a. Light intensity - students should measure the depth of light penetration using either a secchi disc or photometer. This would best be done off a dock or boat so the water is not muddy. The depth of light penetration tells us a couple of things. The first is the depth to which green plants can live. In order for rooted plants to live in the pond it must be shallow enough so that the light can reach the leaves. Sunlight will also warm the water and the temperature will influence the community composition.

b. Detritus sample - Students can determine the relative amount of detritus in each seral stage by removing a sample of the material with a trowel and examining it in a white enamel pan. Student's should also record any observations of invertebrates in the detritus.

c. Diversity of plants - In the floating and emergent plant stage, students should record the kinds and numbers of plants which transect the twenty feet of rope.

d. Deep H_2O Sample - Each team should pass a 10 1 sample of water through the plankton net. Students should remove the large test tube from the nylon net and pour the sample into a collecting jar. A label on the jar should include the date of collection, location of the site, and the collector's name. Once the students return to the classroom, they can observe the plankton under the microscope.

e. Seine and Sweepnet sample - Students should sample the fauna in each seral stage with the nets. The students can examine the contents of the net in a white enamel pan. Each team should record the kinds and numbers of organisms found in the sample.

f. Water analysis - If a test kit is available the tests can be made at the site or back in the classroom. One should make sure that no air bubbles are trapped in the bottle when collecting the sample. Also avoid taking the sample at the edge or surface of the pond.

3. Synthesizing Strategy

The students should discuss how each community altered its physical environment and created conditions which it could not tolerate. For example, each seral stage increased the amount of detritus in the pond and reduced the amount of light which reached the bottom of a pond. A discussion of the study should also address the basic trends in the structure of the community during succession. As succession proceeds: the number of strata in the community increases, the biomass of the community increases, and the communities species diversity increases. The instructor should explain that the small organisms, which inhabit the deep water areas of the pond are plankton. You should also explain the importance of plankton in aquatic ecosystems. The instructor should also discuss with students that as a pond develops it undergoes eutrophication. Students, however must realize that human activities can greatly accelerate the "aging of a water body".

4. Suggestions on Time and Problems.

If the activity is too long to complete in one day, then students can place the sample of Detritus in a plastic bag and the sample from the sweepnet in a collecting jar. Students should label both samples. During a subsequent meeting, the students can examine the samples in the classroom. The observation of the plankton can also occur during subsequent meetings.

The instructor should have a good background in aquatic biology. The synthesizing strategy is brief since there are so many areas one could dwell on. Develop a theme and have the students use the data to synthesize the concepts and specifics you want emphasized.

CHECKLIST

PLANTS

- Submergent
    - Pondwood *(Potomogeton)*
    - Algae
- Floating - leaved
    - Creeping water primrose *(Jussiasa repens)*
    - Duckweed
        - Smaller *(Lemna Minor)*
        - Giant *(Spirodela Polyrhiza)*
- Emergent
    - Heart-shaped Water Plantain (*Alisma subcordatum*)
    - Cattails
    - Common *(Typha latifolia)*
    - Narrowleaf *(Typha augustifolia)*
    - Sedges
    - Lean *(Cyperus strigosus)*
    - Scirpus atrovirens
    - Bulrush *(Scirpus americanus)*
    - Blunt spikerush *(Eleocharis obtusa)*
    - Common Arrowhead (Sagittaria latifolia)
- Pioneer trees
    - Cottonwood
    - Silver maple
    - Willow

ANIMALS

- Aquatic
    - Snails
    - Damselfly nymphs
    - Dragonfly nymphs
    - Common midge fly larvae

  - Springtails
  - Water Striders
  - Ducks
  - Frogs
  - Crayfish (burrows)
  - Fish (Largemouth bass, Channel Catfish, Green sunfish, red-ear sunfish)

Terrestrial

  - Damselfly adults
  - Dragonfly adults
  - Killdeer

Characteristic Plants & Nesting Birds of 4 Midwestern Seres (varied sources)

POND OR RESERVOIR

Open Water
Eelgrass-Pondweed
Eaterbird Visitors

Bays & Shallows
Water Lily-Duckweed
Black Torn-Grebes

Marsh
Cattail-Burreed
Redwing-Marsh Wren

Shrub
Alder-Dogwood
Alder Flycatcher
Yellow Warbler

Wet Meadow
Sedge-Smartweed
Swamp Sparrow

SAND DUNE

Upper Beach
Sand Bur-Beachgrass
Vesper & Lark Sparrow

Dane Shrubs
Chokecherry & Juniper
Chipping Sparrow
Prairie Warbler

Open Forest
Cottonwood-Black Cherry
Kingbird

Conifer Forest
Jack Pine-Red Pine
Black throated Green Warbler

Wet — Wet Mesic — Mesic Forest — Dry Mesic — Dry

Mesic Forest
Oak-Hickory-Maple-beach

HYDROSERE — XEROSERE

Lowland Forest
Elm-Ash-Box Elder
Chickadee-Redstart

Floodplain
Cottonwood-Sycamore
Yellow-throated warbler
Parula Warbler

River Bank or Bar
Willow-Silver Maple
Prothonotary Warbler-Warbling Vireo

FLOODPLAIN or ISLAND (running water)

Pioneer Forest
Cottonwood-Elm-Locust
Brown Thrasher-Towhee

Shrub Thicket
Raspberry-Rose-Sumac
Catbird-Yellow br. Chat

Grass Perenniels
Bluegrass-Goldenrod
Meadowlark-Grasshopper Sparrow

Bare Ground-Annuals
Sweet Clover-Ragweed
Killdeer-Horned Lark

CLAY SPOILBANK

WORKSHEET FOR POND SUCCESSION STUDY

	Seral Stages			
Parameters	Deep-Water	Submerged	Floating-leaved	Emergent
light intensity at water or ground surface				
Relative amount of Detritus				
Number of Strata				
Biomass of plants in terms of height				
Kinds and numbers of plants along 20' transect				
Kinds of plants & animals in deep-water sample				
Kinds and numbers of animals in sweep sample				

General observations:

Type of succession at study site:

FOOD WEBS

MAJOR INSTRUCTIONAL GOAL:

To help students develop an understanding of food chains, energy flow, and predator/prey relationships.

ASSOCIATED CONCEPTS:

A. Food Chain
B. Food Web
C. Predator
D. Prey
E. Producer
F. Consumer
G. Decomposer
H. Niche
I. Competition

BEHAVIORAL OBJECTIVES:

Upon completion of activity students should be able to...

1...give three examples of food chains;
  A. one which would be present in that area
  B. one of which would include man as a part
  C. one other
2...identify producers, primary, secondary and tertiary consumers in those chains (#1)
3...explain what happens to plants and animals when they die. (decomposer)
4...explain how energy flows from one organism to the next by demonstrating a food chain.
5...explain competition as it relates to animal niches (5-8)
6...give an example of predator-prey relationships

BACKGROUND INFORMATION:

All living things depend upon energy to live. This energy flows from one organism to another. To begin, "green plants use minerals and water from the soil, carbon dioxide from the air, and energy from the sun to manufacture food. Plants (producers) provide food for some animals. These plant eaters are called primary consumers and are the food, or prey of other animals-secondary consumers. Tertiary consumers are yet larger animals that get their energy by feeding on secondary consumers. Those animals that are doing the consuming are called predators. Those being consumed (hunted) are prey. (Predator - Prey relationships)

Eventually, all animals and plants die and decay into the soil. Organisms called decomposers feed on this dead organic matter, breaking it down into nutrients, providing minerals to be used again by green plant.

Animals have their own niche, or way of life (function). They become adapted to eat certain things and hunt in a specific territory. This causes competition among animals who eat the same things. However, many different species of animals can live in the same area without competing because they have different niches.

THE ACTIVITY:

A. Information

1. Learning Site - Requires little space, indoors or outdoors (a good rainy day activity)
2. Materials - Pictures of plants, animals, insects and humans which would be fit to form several food chains; ball of string.
3. Preparation by Instructor - Find several pictures of plants and animals (making sure they include producers, primary, secondary and tertiary consumers) cut out and glued on construction paper. Prepare a poster of a food web.
4. Critical Vocabulary - Food chain, food web, predator, prey, producer, consumer, decomposer (5-8) niche, competition.
5. References

A. Who Eats Whom? a T.O.N. Activity

5. (cont)

   B. Food Chain Game an O.B.I.S. activity

   C. The Biological Sciences, Frazier and Smith, IL, Laedlaw Brothers, 1974.

   D. Ecology and Field Biology, Smith, NY Harper and Row, Second edition, 1974

   E. Ecology, Odum, NY, Holt, Rienhart and Winston, 1963.

B. Directions for Actual Learning Activity

1. Focus - Have the students sit down around you. If conducting the activity outdoors, take them to the site to be used. Explain the flow of energy through the food chain using the terms producer, consumer, and decomposer.

(Sun → plants → animals → death → decomposer)

Give some examples including some which might arise in the activity.

(owl → rabbit → plants) (man → cow → grass)

Have the children identify the producers and primary, secondary, and tertiary consumers in these examples. Relate the terms predator-Prey relationships and niche and competition.

2. The Activity - Explain to the students that they are going to form animal food chains. They each will draw from a bag a picture of either a plant (producer) or a animal (consumer). There will be primary, secondary, and tertiary consumers, all or most of which will fit together to form food chains. They will pin their pictures to their shirts or hold them for everyone else to see. Those who are producers must stand in one place as plants do and the consumers will hunt for their prey, keeping in mind that the animal they have chosen

only eats certain things. That is, a plant eater will find a producer, a secondary consumer will hunt a primary consumer etc. When they find the appropriate prey they link arms until the food chain is formed or time is up. Tell the students they have a time period of 5 minutes to hunt in each game (to represent a day). If they do not get into a chain or are incorrect then they have not survived and must stand to the side to decompose. Those who are in food chains may take turns identifying their roles. Play at least 2 or 3 times.

An alternative is to start a food web with the sun (instructor). Ask a student what organism would utilize the sun in the chain. The student will hold onto the string and a second student must name an organism that eats the plant portrayed by the first student. A chain is constructed with the string being used to show the connections in the food chain.

Next ask the students if they can name any other links that would exist in the food chain. Join those students with the string thus creating a food web. Remove one of the students by saying a pesticide or blight killed all the organisms of that species. Ask the students what will happen to the food web.

3. Synthesizing Strategy - At the end of the activity, have the students sit down around you again and discuss:
   1. Who or what didn't survive in each game? Why?
   2. How many and who were the predators?
   3. How many and who were prey?
   4. Was there any competition?
   5. Were the different niches of the same animals?
   6. What happened when there were more predators than prey?

3. (cont)

   6. What happened when there were more prey than predators?
   7. What (would have) happened to those that didn't get into a food chain? (Decomposers)
   8. Name some food chains in this area.
   9. Where does man fit into food chains?

ACTIVITY:

Relationships Between Populations

SUBORDINATE EE GOAL:
Ecological Foundations A

Grade Level: 2-5

Major Instructional Goal: To familiarize students with the different relationships that exist between populations.

Associated Concepts:

A. Population
B. Mutualism(++)
C. Commensalism (+0)
D. Neutralism (00)
E. Competition (--)
F. Predation (+-)
G. Parasitism (+-)

Skills:

A. Matching
B. Concept Synthesis
C. Observation
D. Classification
E. Communication
F. Inferring

Behavioral Objectives: Upon completion of this activity the student should be able to:

1. Give a definition of population and cite 3 examples of different populations.

2. Explain to the group how the species on their puzzles affect each other.

3. Give one example, drawing upon information from the puzzles, of each of the following population relationships: ++ (mutualism) +0 (commensalism), +- (predation and parasitism), 00 (neutralism), and -- (competion).

4. Identify various relationships between populations that are discovered by the instructor and students.

5. Correctly decide if competition is taking place between organisms when he is shown specific examples. (If he is shown a lichen on a rock, insects in a rotten log, or honeysuckle on trees, he should be able to tell if competition exists in any of these situations.

6. Find, along with a partner, one example of the

6. assigned population relationship given to them and explain to the other group members the reason(s) for their selection.

7. Give one example of how species within the same community influence one another (e.g. animals such as ants or bees work together to obtain food and build shelter, bobcat and deer both fight or compete amongst themselves for mates, food, and territory.

Background Information: For T.O.N. Instuctor

Relationships between populations-

population - group of interbreeding organisms of the same kind occupying a particular space. Plants and animals of the biotic community exhibit a wide range of relationships to one another. Some populations have little influence on one another except in the indirect and often distant role they play in energy exchange. Other populations such as parasites and their hosts or predators and their prey have a very direct and immediate relationship. From an individual standpoint these relations often are detrimental; from a population standpoint they may act either as a depressant or as a stabilizer of population numbers. Such interactions influence the growth rate of a population (Smith 1977 pg. 366).

Theoretically, populations interact in six ways. A table of these relationships between population, along with their explanation is below.

RELATIONSHIPS BETWEEN POPULATIONS

	+	0	-
+	++	+0	+-
0	+0	00	0-
-	+-	0-	--

+ = positive effects
- = negative effect
0 = no effect

++Mutualism - both organisms benefit form the relationship. There are two kinds of mutualism, obligatory and protocooperation. Obligatory mutualism is a situation in which the two organisms evolved to depend on each other.

Example - lichen fungi (hyphae supports the plant which supplies the food.

Protocooperation is when organism are non-obligatory.

Example - root nodule bacteria. The host plant can survive independently but when they are together they both benefit.

Mutualism is often termed symbiosis. Actually, symbiosis means "living together" and includes mutualism, commensalism and parasitism.

+0 Commensalism - one organism benefits, there is no affect on the other

Example- epiphytes such as orchids. These plants grow on tree branches enabling them to get adequate sunlight. Their roots draw nutrients from the humid air. Spanish Moss and Old Man's Beard are other plant examples. An example of an animal commensalism is barnacles that attach themselves to ships or shell of horseshoe crab. Also, burrows of many animals may be occupied by others. Woodchuck burrows may be used by cottentail rabbits, woodpecker holes by bluebirds or wrens.

00 Neutralism - the organisms are not affecting each other.

-0 Commensalism- one population negatively affects or inhibits another population while remaining unaffected itself. Commensalism commonly involves some type of chemical interaction with other organisms.

Examples - fungi secrete hormones that prevent bacteria from forming, walnut trees produce juglone, which oxides in the soil to a substance that inhibits the growth of certain understory species such as blackberry, bluegrass, heaths, and broadleaf herbs.

+-Parasitism and Predation two organisms live together but one drives its nourishment at the expense of the other. Parasitism parasites draw their nourishment from their host but usually do not kill them as in the case of predators.

Examples - brain worm affecting white tail deer, ticks on animals, and mange (parasitic mite) on dog or fox.

Predation is a step in the transfer of energy. It is in the broadest sense one organism feeding on another living organism. There is overlap between predation and parasitism.

For example, one organism, is this case, the parasitoid indirectly attacking the host, or prey, by laying it's eggs

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in or on the body of the host. After the eggs hatch, the larvae feed on the host until it dies. The affect is still the same as that of predation. The concept of predation can also be extended to grazing herbivores preying upon the plants thus affecting the plant populations.

Example - deer preying upon twigs, beaver preying upon bark, hawk preying upon a rabbit or snake, and snake preying upon a rat. (To eliminate confusion a predator can be defined as an animal that captures its prey. This would mean that the deer and the beaver used in the above examples would not be predators. Only the hawk and the snake.)

Competition - both organisms are adversely affected. Complete competitors can not coexist. If two noninterbreeding populations occupy exactly the same ecological niche, in the same geographic territory and if one population multiplies even the least bit faster than the other, eventually the first population will occupy the whole area and the second population will become extinct. Through the evolutionary process, species have become diversified enough so they do not occupy the same resources. There are two types of competition between populations.

Exploitation happens when two or more species have access to limited resources. The outcome is determined by how effectively each of the competitors utilizes the resources. It is a scramble type of competition.

Example - moose and snowshoe hare both browse on the same food in the same areas, shiners and small trout also do the same. The other type of competition is interference. One competitor is denied access to the resource, usually by some form of aggressive behavior. Example - some darters defend territory against other species as well as their own, redwing blackbird competes against tricolored blackbird for teritory.

The Activity

A. Information -

1. Learning Site - any small area either inside or outside can be used for the puzzle phase of the activity. Utilize one or both (creating a loop) of the two trails leading from the YCC camp to Little Grassy Lake for the hiking phase of the activity.

2. Materials - puzzles made of cardboard and magic markers. Each student should have one piece of puzzle that fits into only one other piece creating a two piece puzzle. If there is an uneven number of students, the instructor should participate.

   Examples for puzzles -
   (-0 (ammensalsism) is not dealth within
   this activity just the 6 relationships below)

++ (mutualism) 1. hyphae + algae (lichen) 2. honey locust + nitrogen fixing bacteria in root nodules 3. blackberry bush + birds (seed dispersal) 4. squirrel + walnut tree.

+0 (commensalism) 1. poinon ivy + tree branches 2. barnacles + horseshoe crab 3. lichen + stone 4. old woodchuck burrow + rabbit 5. nesting sparrow + tree 6. old ruin + field mouse 7. mosquito + pond 8. beggar ticks + man 9. turkey vulture + dead rabbit 10. mushroom + rotten log.

+- (parasitism) 1. ticks + man 2. ring worm + wolf 3. fleas + dog

+- (predation) 1. mosquito + man 2. snake + frog 3. bass + bluegill 4. hawk + rabbit 5. man + deer

00 (neutralism) 1. day lilly + maple tree 2. elm tree + honey locust 3. turtle + squirrel

-- (competion) 1. sassafrass tree + sumac tree 2. water snake + bass 3. bear + badger 4. honeysuckle + virginia creeper 5. wolf + coyote

Chalkboard and chalk (or a poster) showing the between population relationship table (given in background information) and also use it for writing down examples and vocabulary words.

3. Preparation by Instructor - Find out the number of students in your group and secure enough puzzles for two games. (Two students use one puzzle per game.) Select the game area and trail. Walk the trail identifying relationships between populations that you would like to point out to the students.

4. Critical Vocabulary - Population, relationship, predator, parasite, competition, territory, organism, and individual.

5. References, Tips, Hints, Worksheets or Handouts - A. Ecology and Field Biology. Robert Smith. NY: Harper and Row, 1966. B. Dynamic Ecology. Collier, Cox, Johnson, and Miller. NJ: Prentice-Hall Inc. 1973.

B. Directions for the Actual Learning Activity

1. Focus - Time: 10 minutes
Take the students to the study site and explain that they are going to study relationships between populations. Define the words relationship and population, giving examples of various populations as well as asking for examples. Tell the students there are 6 different relationships that exist between populations. They are going to learn all 6 and will be able to find examples of each.

2. Have the students give you their puzzle pieces. Place enough different puzzle pieces in the center of the study area for the second game. Again, each student is to select one puzzle piece and find his match. When they find their partners they are again to sit down and wait for everyone in the group to find

their partners. This time each partnership must stand up and explain to the other group members their relationship. For example - +- mosquito + man. It is good for the mosquito because he gets food, but it is bad for man because it irritates his skin and causes discomfort.

After everyone has discussed their relationship, collect the puzzle pieces.

Tell the students they are now to find examples of difference between population relationships. Take a walk down to the lake using the trail you have familiarized yourself with. Point out different relationships. Ask the students what kind they are. Also have the students point out relationships. By the time you have reached the lake, all should have a good idea of the 6 different relationships.

Now divide the group into partners. Give each partnership a specific difference between population relationship to find. They must be able to explain to the group the reasons for their selection. When they have found their relationship they are to come back to the spot they are now at (the rock ledge is a good meeting and discussion spot).

After everyone returns, go to each partnership's site and have them justify their selection to the group.

Go back to the rock ledge for discussion.

3. Synthesizing Strategy - Time: 10 minutes
BE SURE YOU HAVE 10 MINUTES LEFT TO WALK BACK TO CAMP.

Have the students sit in a circle and discuss the following:

1. What is a population?
2. What are the 6 different relationships between populations? Ask for examples.
3. What is competition? Is it good?
4. Give an example of a predator relationship. A parasitism relationship.
5. Now that we have discussed relationships between populations, could you give me some relationships that could exist within the same population? If no response, ask Do animals of the same species help each other or compete with each other? How?

4. Suggestions on Time and Problems.

B. Specialized Adaptations to Meet the Needs of Various Handicapping Conditions

The basic structure of an Environmental Science program remained the same for these handicapped students, with only minor adaptations employed to overcome the limiting conditions imposed by the nature of their handicap .

For the deaf student his/her greatest handicap exists in understanding the abstract concepts covered in the course. Simplification of even the most basic words is necessary and as with all good teaching, relating the new to something with which they are already familiar is critically important. The summer institute program employed a deaf interpreter for the entire program. This interpreter was assisted with her responsibilities by another staff member who had completed her degree in deaf education. In addition, all the residential staff quickly learned the sign alphabet and those basic signs which allowed them to carry on informal conversations with the deaf students.

During the first session of the Institute a number of captioned films on ecology were utilized as supplemental enrichment. The success of this effort was perhaps limited by the fact that these films were added to the schedule at the last minute. If they had been more carefully integrated into the program, they would, in fact, have been more useful due to their generally good quality.

Perhaps the most intellectually demanding aspect of the program for the deaf student was the introductory lecture each morning. The nature of many of the outdoor educational activities was such that the students were concretely involve in hands-on exploration of nature, or graphic depictions of the concepts. A good example of this is the Food Web Activity, which requires students to take the part of certain animals and re-enact the absorption of food through predatory behavior.

The blind student combines difficulties with conceptualizing with lack of experience with his or her physical environment upon which to draw a frame of reference for the new material he is learning. Since the largest part of learning in our society takes place through the sense of sight, those things the sighted person takes for granted must be adapted for the blind. The blind students, as a rule, did not enjoy the films which were viewed by the other students. Since these films were reinforcement and enrichment of concepts, it was not critically important that they be well-received, but consideration should be given as to whether or not they are worth using with a large group of the visually impaired. A counselor at the elbow of each blind student during the film to provide a narrative account of the scenes projected was of some help to the blind students.

The visually impaired student had many direct tactile experiences with nature in this program--feeling the veins of a leaf, utilizing the "Touch Box" at the Nature Center, holding a bird to be stuffed (pheasant, owl, scarlet tanager) all were opportunities unique to him/her.

Certain outdoor activities, particularly the "games" utilized the kinesthetic sense to teach - that is, students "acted out" the concept. A careful look at the session plans for these activities illustrates this point. Students were also encouraged to use their senses of taste and smell. Bypassing the visual in this manner assists the blind student and the concreteness of the experience is of advantage to the hard-of-hearing student whose level of abstraction is lower than average.

Vision impaired students were helped in the lectures by providing them with large print notes, magnifying glasses, audio tapes and a counselor at their elbow to help clarify understanding.

Other adaptations to the activities included pre-cutting the pieces for construction of bird houses to reduce the level of complexity and simplifying the site development activity to permit all students to become involved at the level of their mobility.

Because it *does* take extra energy, muscle power and planning to involve handicapped youngsters with a variety of disabilities in an outdoor laboratory experience, many instructors might advise them against taking a course which requires these adjustments. But it *can* be done.

The orthopedically handicapped youngster, as the results of the evaluation indicate, had the least problem in comprehension. This student raised logistical problems for the instructor. Those who did not have fine muscle control - as a result of cerebral palsy - were unable to actively participate in the games. Their eyes did the walking, touching, and feeling. But even with these students, the assistance of the counselor-aids at their side during each of the activities made it possible for them to do more than expected. They could read directions during the water analysis exercise to the blind youngsters who became the "hands" for this simple experiment.

Manpower was always necessary to move him/her from one site to the other. While the youngster in the wheel chair could not utilize the seine net to dredge for life in the ponds, he could use the plankton net, if his wheelchair were close enough to the water. He would examine plant specimens which were placed in his chair, and view specimens under the microscope if it was placed upon his lap board.

Adapting the outdoor activities to the needs of this specialized group of students was much less involved than anticipated in the original proposal.

Only a few of the activities needed modification. This included revising the "Who Eat Whom" activity for blind students by adding noise. The color of flags made it easy for deaf students to distinguish the predator-prey relatio ship. The "Aquatic Food Chain" activity gave the blind students an experience they otherwise would not have had, to feel many of the organisms first hand.

Once wheelchair students were conveyed to the site (an awkward and cumbersome effort because of the wet ground) many were able to do some of the sampling themselves.

The instructors found that the "Garbonzo Bug" activity was one of the most easily accomplished with a group of students with mixed handicaps because each student could help another.

As with the Garbonzo activity, the "Quadrat Study" is a multidiciplinary approach to Environmental Education. This activity incorporates elementary math, ecological concepts and various observational skills. It proved most difficult for the wheelchair students because of the need to travel some distance to complete the activity.

Of all the environmental activities which the students completed, the aquatic ones were most successful with this special population. Most were able to collect and identify specimens and this new opportunity really held the attention of all, including the blind.

RECREATION

III. RECREATIONAL PROGRAM

As indicated in the schedule of sessions, each day's activities alternate between educational and recreational components. Underlying the planned recreation was the hope that each youngster would use the opportunities provided to grow socially and to further develop a feeling of confidence in the out-of-doors and in one's ability to derive increased energy and satisfaction with mastering a new skill.

Many of the recreational activities were planned to agument the academic curriculum. Some, however, were designed to be a total break from the regular routines.

Students had the opportunity to rappel down an 80-foot cliff at Giant City State Park, climb behind a gently cascading waterfall at Fern Clyffe State Park, swim in the Olympic-pool at the Southern Illinois University Student Recreation Center, go to the latest movie and shop at the University Mall in Carbondale, canoe and swim at Little Grassy Lake, and hunt for owls on an evening hayride. Each group of youngsters gave themselves a party one evening and many informal hours were spent throwing frisbees, playing cards and board games or listening to music.

One youngster spoke for many when he wrote his reaction to the experience of letting himself down the side of a cliff by a rope.

ACHIEVEMENT - by Matthew Wilson
(assisted by Don Dailey)

I went down the cliff for the first time

I had a tingling sensation down my spine

On the way down I could see all around me

I had the strangest feeling of being free

While descending slowly into space
At the top I couldn't see another face

I'd be lying if I said I wasn't scared
Because everyone has their moment of fear

Soon my feet came to rest
I knew inside that I overcame the test.

Others expressed their pleasure with the fact that they had made new friends and had grown to care for each other. The importance of allowing this "white space" when planning an intensive learning experience can not be overremphasized. Much of the success of a program is related to the interaction of all the participants in pleasurable new activities. If properly planned, this sense of accomplishment and achievement in the social sphere will carry over to greater enthusiasm and appreciation for the academic as well. Students were given the opportunity to comment on the program at the end of the formal evaluation. As the selection of comments which follows indicates, they enjoyed both the social and academic aspects of the program.

Please add any further comments you might have I thank-you for allowing me the chance to come, and I would come back if I could.

Please add any further comments you might have

Walking in the forest

Please add any further comments you might have I love all the people in this camp Because they are very nice to me. I will miss you ....!

This has been an experience that I will use and remember for the rest of my life and I will be able to help other people learn

Thank you. about ecology by doing this.

Please add any further comments you might have I Think This camp was great I would love To see it go agian nexT year. I'll miss you all!!!!

Please add any further comments you might have Well, I especially liked making new friends and all of the fun and excitement!

Please add any further comments you might have this is the most interesting camp I have been To, and I hope to come again.

Please add any further comments you might have I hope you have this camp again.

Please add any further comments you might have I enjoyed the informal atmosphere and I learned a lot.

Please add any further comments you might have I didnt see the movie or go reppelling or go to the swamp

Please add any further comments you might have I l Wes a good Program

Please add any further comments you might have I wish there would have been more male staff. I had a lot of fun. I hope to be back next year.

Please add any further comments you might have I dont like water because of a bad experience years ago - I did not go to swamp or on pontoon or swimming.

Thank you.

Please add any further comments you might have I Wished There Could Have Been more Swimming Activities or Fishing.

Please add any further comments you might have I was very glad I came. I've extended my science knowledge a lot since I came to this camp.

Thank you.

Please add any further comments you might have

Let somebody know that Paul Irving needs a job & would like very much to work here !!!!!!!

Please add any further comments you might have I enjoyed the whole course.

Please add any further comments you might have During the fast two weeks it had been excellent. But I realy can't tell what i realy feel in first two week, because I wish

Thank you. I could stay a week more.

Please add any further comments you might have I want to bring this camp back to the interests of the President and Reps., so we could have the camp again next year!

Thank you.

A description of all recreational activities can be found in the full schedule of the session. In general, the younsters had one planned activity every day which was related to the science program, - such as learning to canoe before they went to the swamp or searching for owls while taking a moonlit hayride - and one structureless recreational period whereby they could socialize lazily on their own.

To avoid becoming too structured and rigid the schedule remained as flexible as possible and occasional changes were made in each day's "official schedule" to account for variations in the weather and energy level of the youngsters. This approach paid dividends by the high degree of satisfaction that the youngsters had with the program overall. The younger staff members of the Environmental Workshop staff spent many hours voluntarily playing the guitar or quietly socializing with the students. The project directors feel this was an important constructive element added to the overall program.

EVALUATION

IV. EVALUATION

Assessment of the outcomes of the program took three major forms:

A. A pre-test, post-test of the comprehension by students of the ecological concepts taught in the course;

B. An evaluation form of overall satisfaction with the program activities and facilities completed by the participants;

C. An evaluation form completed by staff which asked both instructors and counselors to assess various parameters of the program including overall effectiveness of the activities--perceptible differences in each group of students which impacted upon outcomes of the program--and growth in oneself as a result of involvement in the program.

Many of the positive outcomes of the program were unplanned. Although the social dimension is a critically important factor in overall satisfaction with a learning experience, there was little attempt to program for some of the positive social outcomes which evidenced themselves throughout the course of four weeks.

A. Pre-Test, Post-Test Instrument

The instrument which tested comprehension of fundamentals of ecology consisted of thirty multiple choice and true-false items. This instrument was adapted slightly from the test utilized by the Environmental Workshop Program for assessment of regular teacher and student environmental training activities conducted at the Center. Some items which were not taught in the course of two weeks were removed from this test. See Appendix IV for a copy of this instrument.

Unfortunately, since an entirely newly constructed instrument was not developed, the instrument used did not assess the concepts taught in equal propproportion to the amount of time spent of teaching each student. (See

Table 4). This fact must be taken into consideration when analyzing the results of the pre-test and psot-test for each of the groups. While amount of time spent teaching a concept should not parallel completely the number of questions constructed on a test, there should be a fairly even proportion between amount of instructional time and amount of testing on a concept, it is important that the structure of the questions be such that the student not have undue difficulty answering them even if he understands the concept. There were 70 vocabulary words entirely new to the students on this test. This fact also should be taken into consideration when analyzing the test results.

B. Results of Test of Ecological Principles

The students in the first session (4 deaf, 4 blind, and 3 orthopedically handicapped) very quickly became friends and appeared to the staff as much more interested in the social opportunities provided by the Institute than in the adademic opportunities. (See Table III.) They scored higher on their pretest than the second session students, but improved their scores on the post-test very little, 10%.

In contrast, the second session had 1 deaf, 2 blind, 7 in wheelchairs, 2 epileptic students, and 2 on crutches. This group seemed more attentive during learning activities and studied more during their free time. Their pre-test scores were quite low but showed a drastic average improvement of 20% on their post-test.

The orthopedically handicapped students showed the greatest improvement from the pre-test to the post-test: 23%. This seems to say that they have not been given opportunities to learn field biology in the past, and given the opportunity, they respond very well. Providing opportunities for the orthopedically handicapped seems to involve only providing time and muscle to put the students into and out of transport and pushing wheelchairs over somewhat rough terrain.

The results of the test instrument as indicated in Table III.

Table III

Percentage of Items Answered Correctly

	Average Pre-test	Average Post-test	Average Improvement
Epileptics (2)	46.62	54.95	8.33
Deaf and Hearing Impaired(5)	49.95	67.93	17.98
Blind and Vision Impaired(6)	58.61	69.26	10.66
Blind (No Emotional Problem) (4)	62.27	79.92	17.65
Crutches (2)	41.63	68.27	26.64
Wheelchairs (11)	46.29	68.60	22.31
Wheelchairs (No Emotional Problems or Learning Disabilities) (9)	45.95	73.93	27.97
Orthopedically Handicapped (13)	45.62	68.60	21.98
Learning Disability (2)	49.95	38.30	11.66
Emotional Problems (3)	48.95	51.28	2.33
First Session (10)	54.28	64.27	10.99
Second Session (16)	46.29	67.27	19.98

The students with vision impairments showed an average increase in their scores of 11%; the hearing impaired students improved 18%.

Three of the students in the Institute showed severe emotional handicaps (e.g., immaturity and emotional dependence on the staff) which prevented them from learning what was taught, or even participating adequately in any aspect of the program. They showed an average of 2% improvement in their post-test scores. We feel that their real handicaps are not their physical disabilities but their emotional ones. Two of the emotionally troubled students were blind. If their scores are removed from the blind students' total, the other four blind students show an average post-test score improvement of 18%.

One orthopedically handicapped student had a learning disablility and another was emotionally troubled. If their scores are subtracted from those in the wheelchair category, the improvement shown by the wheelchair students is a truly remarkable 28%.

If emotionally handicapped students are included in programs like this one, help must be provided for their emotional problems if they are to reap any benefits from the activity. Students who did not have learning disabilities or emotional handicaps showed reasonable improvement in their post-test scores, even considering the inadequacy of the test used.

As a direct result of the analysis of the cognitive outcomes of this program, the project directors felt that there was a need for college level instructors to become more involved in the total needs of the handicapped student. Therefore, in August, 1982 they submitted to the Office of Education's Research in Education for the Handicapped Program a proposal dealing with science instruction for the visually impaired in a university setting which stressed the importance of a second curriculum directed towards the affective aspects of the student's behavior.

Dr. Paul Yambert, who was asked to assist in validating the test instrument made the observation that "overall the test should do a good job of measuring what it is intended to measure. My chief reservation regarding this is that I think it is probable that too much 'new' vocabulary may have been introduced, so students may have learned the concepts but not answer questions about them correctly."

The project directors agree with Dr. Yambert's assessment and regret that this information was not received and considered prior to utilization of the tool.

An analysis of how the students performed on each test item appears in Table IV.

See Appendix for complete copy of test instrument.

Table IV
Number of Students
Correctly Responding to Each Question

Questions 1 - 10	Session I	Session II	Total	Objective Tested
a. amount of energy stored in organic material	5	7	12	D
b. ability of environment to support a population	5	9	14	C
c. condition which inhibits growth	8	7	15	C
d. change of plant species through time	8	14	22	G
e. rivalry between different species	5	7	12	B
f. rivalry between same species	6	10	16	B
g. series of organisms depending on preceding food source	7	15	22	D
h. producer's place in food chain	4	9	13	D
i. definition of consumer...	8	15	23	D
j. a habitat is ...	9	13	22	E

Questions 11 - 20

k.	definition of a niche ...	7	11	18	C E
l.	plants and animals in a pond are ...	6	9	15	E
m.	a community is ...	6	10	16	E
n.	term for an animal directly attaching another	6	6	12	B
o.	Eutrophication is ...	3	8	11	G I
p.	mushrooms are ...	7	11	18	D
q.	coping mechanisms of organisms ...	5	9	14	C F
r.	a properly sequenced food chain ...	9	13	22	D
s.	largest number of hardwood trees in Illinois	6	9	15	C D
t.	greatest number of organisms one area can support	9	12	21	I

Questions 21 - 30

u.	man's influence on ecosystems	6	6	12	A G
v.	Good wildlife habitat	9	13	22	C
w.	major cause of reduction of wildlife	6	10	16	B I
x.	example of sustained yield management	4	8	12	I H
y.	farmers utilize fertilizers to ...	6	10	16	D H I
z.	biodegradable is a substance	5	11	16	H D
aa.	best utilization of a food chain	4	8	12	D
bb.	clearing natural vegetation for urban growth	6	10	16	I
cc.	succession in forest is like life in the cities	8	14	22	H
dd.	marine creatures called diatoms	4	6	10	G

Participant Evaluation Form

At the completion of each session of the Institute the student participants were asked to complete an evaluation form assessing satisfaction with the full scope of the program. A copy of this 29 question evaluation appears as Appendix 4.

Areas of highest safisfaction (total score of 16 or over on agreement) included the recreational activities, lakeside instructional activities, trips to the Nature Center, and Pollution Control Center, construction of the bird house, site development, the "Baoobab" film, and the lectures on: Forest ecosystem, interdependence and flow of energy.

The aspect of the entire program which scored the lowest satisfaction was "food," question 10, although it approached an even spread with 11 students agreeing the food was good, 9 feeling neutral, 12 disagreeing. The highest other level of dissatisfaction was "swimming" with four students disliking this activity. Some of these youngsters were unable to swim because of the seriousness of their handicapping condition or extreme fear of drowning. Table V indicates those areas of greatest satisfaction.

Overall, the students were highly responsive to the program, positive in their feelings towards the staff and wishful that they could have remained longer or returned.

Table V
Results of Student Evaluations
(26 Students)

1. Satisfaction with Selected Educational Activities

	Satisfied	Neutral	Dissatisfied
a. "Baobab - Portrait of a Tree"	19	6	1
b. Flow of energy lecture	16	10	0
c. Outdoor "food" games	19	6	1
d. Seining in the lake	20	5	1
e. Plant examination	19	6	1
f. Natural Cycle lecture	14	11	1
g. Dredging in Pontoon Boat	18	6	1

Table V

Results of Student Evaluations
(Con't)

		Satisfied	Neutral	Dissatisfied
h.	Microscopic examination of water specimens	10	11	2
i.	Examining animal specimens	20	3	2
j.	Forest ecosystem lecture	17	9	0
k.	Succession in Oak/Hickory Forest	18	7	1
l.	Captioned films	13	10	1
m.	Taxidermy demonstration	20	4	2
n.	Lake ecosystem lecture	16	8	1
o.	Lecture on interdependence	16	8	2
p.	Site Management	18	6	1
2.	Satisfaction with Recreational/Educational Activities			
a.	Swimming	17	5	4
b.	Canoeing	23	0	2
c.	Rapelling	21	3	2
d.	Trip to Pollution Control Center	16	8	1
e.	Meals	11	9	2
f.	Recreation Center	22	4	2
g.	Shopping trip and Movie	22	4	2
h.	Fern Clyffe trip	23	2	0
i.	Hayride and Owl Call	21	0	0
j.	Making a bird box	19	13	0
k.	La Rue Swamp trip	17	3	3
l.	Catching fish	15	7	3

The project directors received numerous letters from the participants or their parents after the program was completed - a sample of these appears in Appendix VI.

Staff Evaluation

In addition to assessing the satisfaction of the students with the program, the staff - both instructional and residential - was asked to complete an evaluation form also. This evaluation appears in Appendix 7. The general categories included in this form were: 1) academics, 2) accommodations, 3) staff relations, 4) growth of self, 5) assessment of characteristics of each group of students, 6) overall effectiveness of program in achieving objectives and effectiveness of specific program activities.

Since seven of the ten individuals responding to this questionnaire were strangers to each other at the start of the program, the objectivity which they would bring to the program should count heavily towards a sense of accuracy of perception. The remaining three individuals who completed the form were members of the Environmental Workshop staff of Touch of Nature. In some cases there were questions left unanswered. The staff indicated this was because they did not participate in an activity and therefore could not assess it appropriately.

The following tables indicate the grouped response to each of these categories.

Table VI

Response to Questions 1-7

Staff Evaluation Form

QUESTION	POOR				EXCELLENT
1. Accommodations	1	2	3(1)	4(2)	5(7)
2. Meals	1	2(1)	3(3)	4(4)	5(2)
3. Staff rapport	1	2(1)	3(2)	4(4)	5(3)
4. Staff/student rapport	1	2	3(1)	4(3)	5(6)
5. Staff training	1	2(2)	3(2)	4(2)	5(4)
6. Staff competence	1	2	3(1)	4(5)	5(4)
7. How would you rate the overall scheduling of activities?	1	2	3(4)	4(3)	5(3)

Table VII

Response to Questions 8-12

Staff Evaluation Form

QUESTION	POOR				EXCELLENT
8. Academic effectiveness of films	1(1)	2(2)	3(1)	4(3)	5(2)
9. Academic effectiveness of lectures	1(1)	2	3(1)	4(4)	5(3)
10. Academic effectiveness of field experiences	1	2	3	4(2)	5(8)
11. Programming suitability for special populations	1(1)	2(2)	3(2)	4(4)	5(5)
12. Appropriateness of recreational activities for special groups	1	2(1)	3(1)	4(4)	5(4)

Table VIII

Self-Development

Question 13

QUESTION	POOR				EXCELLENT
13. Growth of self in:					
Ability to work with range of handicapping conditions	1	2	3 (2)	4 (3)	5 (5)
Ability to accept people as they are	1	2	3 (1)	4 (5)	5 (4)
Ability to accept responsibility	1	2 (1)	3 (1)	4 (3)	5 (6)
Understanding of ecological principles and their application to daily living	1	2 (1)	3 (3)	4 (3)	5 (2)
Ability to maintain effective levels of activity for long periods of time close quarters	1 (1)	2 (1)	3 (3)	4 (3)	5 (2)
General physical condition	1	2 (1)	3 (1)	4 (4)	5 (4)

Table IX

Response to Question 14

Characteristics of Students as a Group

Question

14. Compare students as a group in Session One to students in Session Two according to scale H = High, M= Medium, L = Low:

Session I			
Social interaction	H (7)	M	L
Academic interest	H	M(4)	L(4)
Physical demands upon staff	H	M(6)	L(2)
Concentration span	H	M(5)	L(3)

Session II

Social interaction	H(2)	M	L
Academic interest	H(7)	M(2)	L
Physical demands upon staff	H(6)	M(3)	L
Concentration span	H(4)	M(5)	L

Table X

Response to Question 15

Characteristics According to Handicapping Condition

QUESTION

15. Compare hearing-impaired students, visually impaired students, students in wheelchairs, students on crutches and others according to the scale of H for High, M for Medium and L for Low:

Session I

	Crutches			Wheel-chair			Hearing Impaired			Vision Impaired			Others
Session I	H	M	L	H	M	L	H	M	L	H	M	L	
Social interaction	3	1	0	6	1	1	5	3		4	3	1	
Academic interest	3	1	0	2	5	1	3	4	1	3	5	0	
Demands on staff	0	2	2	6	1	0	0	3	4	0	4	3	
Concentration span	1	2	0	0	2	5	1	5	2	1	5	1	
Session II													
Social interaction	5	3	0	3	3	2	5	4	0	3	4	1	
Academic interest	3	5	0	4	2	1	3	4	1	4	3	1	
Demands on staff	0	2	6	5	1	2	0	2	6	0	2	5	
Concentration span	2	5	0	2	4	1	0	7	0	0	1	7	

Table XI

Response to Question 16

Effectiveness of Program in Achieving Objectives

QUESTION					
16. Effectiveness of program in achieving objectives:					
To introduce handicapped high school students to ecological concepts	1	2	3(2)	4(3)	5(5)
To give handicapped students an opportunity to apply these concepts in an outdoor laboratory experience	1	2	3	4(5)	5(5)
To develop self-confidence in areas of experiential science	1	2	3(1)	4(5)	5(4)
To develop students' sensitivity to societal impact and value issues related to environmental planning	1(1)	2(1)	3	4(6)	5(2)
To serve as a model for school systems in methods of adapting science curriculum to the special needs of the handicapped	1(3)	2	3(1)	4(3)	5(2)

Table XII

Response to Question 17

Growth of Students as a Group

QUESTION					
17. Growth of students as a group:					
In self-confidence	1	2	3(1)	4(7)	5(1)
In social adaptability	1	2	3(1)	4(6)	5(2)
In concern for others	1	2(1)	3(1)	4(4)	5(3)

Table XIII

Response to Question 18

Effectiveness of Specific Activities

QUESTION

18. Effectiveness of specific program activities:

Site improvement	1	2	3(2)	4(5)	5(2)
Bluebird box construction	1	2(1)	3(1)	4(5)	5(2)
Succession trail	1	2	3(2)	4(6)	5(2)
Pollution control center	1	2	3(2)	4(2)	5(2)
Aquatic food chain	1	2	3(1)	4(4)	5(4)
Fish management	1	2	3(2)	4(3)	5(5)
La Rue Swamp	1	2	3	4(3)	5(6)
Rotting log	1	2	3	4(5)	5(3)
Lake ecosystem	1	2(1)	3(1)	4(4)	5(3)
Tree identification	1	2(1)	3	4(5)	5(2)
Lima bugs	1	2(1)	3(1)	4(3)	5(3)
Taxidermy demonstration	1	2(1)	3(1)	4(2)	5(4)
Nature walks	1	2	3	4(4)	5(3)
Goober etus	1	2	3	4(2)	5(5)

V. Assessment of Outcomes

The variety of evaluation instruments employed to examine the Summer Institute in Environmental Sciences allows for a multi-faceted look at the program. The students spent 120 instructional hours studying the ecological concepts outlined. They spent 15 additional hours in recreational activities allied to what they were studying. The weaknesses of the testing instrument in giving a true picture of what the students learned have been explained. It is clear, however, that the students did progress along the continuum for absorption of scientific knowledge to an appreciation of the values inherent in the curriculum. This was apparent from their responses to those questions on the Student Evaluation Form which asked them to assess their satisfaction with certain instructional aspects of the program.

There were differences in their response to questions on their enjoyment of the purely recreational activites, but these were small. In fact, the over-all response of the student to the program as a whole was extremely positive. A month after its completion, students and parents were still writing to the project directors indicating their appreciation of the opportunity provided to them. At this time it is hard to say whether or not a two-week activity will redirect their career goals or interest in science, but it has proven to them that science can be interesting and they can find success with it.

The majority of the staff felt that the Institute was educationally sound and that it met four of the five initial objectives quite well. As the various evaluation forms indicated, there was a consistently high level of satisfaction with the nature of the activities employed to teach the students ecological concepts. This satisfaction existed with both the students and the staff.

The challenges represented by this specialized group of youngsters makes the instructional staff realize that there is difinitely still a large job to be done when adapting standardized curriculum to a variety of needs and abilities. This, of course, will be an increasing responsibility for science teachers as more youngsters with handicapping conditions are mainstreamed into regular lab classes. The staff appreciated the opportunity NSF offered them to sensitize regular teachers to these needs and to present to them a series of in-service workshops on the simple means that can be utilized to bring science classes to handicapped students.

VI. Dessemination of Results

The project directors undertook to disseminate the results of this activity to a variety of school systems and science teachers throughout the midwest. One of the major objectives of the dissemination effort was to reduce the attitudinal barrier to participation encountered by the project directors when they recruited students originally.

Those school systems which acted as host to the presentation included:

Chicago Public School System (all 5 districts)
Gary, Indiana Public Schools
Evanston, Illinois Public School
Cincinnati, Ohio Public School
St. Louis Archdiocesan System

In addition to reaching high school teachers, the project directors addressed the Midwest College Biology Teachers Conference in Pella, Iowa. They realized that many of the barriers to participation by handicapped students in science also exist at the post-secondary level.

The directors contacted school systems in Louisville, Kentucky, Indianapolis, Indiana and Memphis, Tennessee also. However, scheduling conflicts in these systems prohibited them from releasing teachers from their instructional assignments during Fall 1982.

Three major topics were covered in each session:

1. Barriers to Participation of Handicapped Students in Science Activities
2. Ecological Concepts covered in the Summer Institute.
3. Adaptations Instructors can make to Science Laboratories, Activities to involve Handicapped Students.

Overheads and color slides were included in the presentation. In addition, attendees received a packet of materials which included:

1. References to selected texts which contain chapters dealing with the ecological concepts covered in the summer institute.

2. A chart for classroom management of the handicapped.
3. Selected activities utilized in the program.
4. A bibliography gleaned from other directors of science programs for the handicapped sponsored by NSF.

Copies of all these materials appear in the appendix.

The presentations were favorably received by each audience. The one formal evaluation conducted by the Cincinnati system was very positive, as the table indicates that follows.

Table XIV

A Formal Evaluation - conducted by the Cincinnati System

Evaluation of Workshop
(11 participants)

1. Overall Evaluation of Program
   a. Excellent (7)
   b. Good (4)
   c. Fair (0)
   d. Poor (0)

	yes	to some extent	no
2. The presentation:			
a. was pertinent to my needs and intersts.	6	4	1
b. gave me ideas that will help me perform my job more effectively.	7	4	
c. was too complex.			11
d. will help my students.	6	5	
3. The presenters:			
a. were interesting.	11		
b. easy to understand.	11		
c. were enthusiastic.	11		

4. Least Effective Part of Workshop

"Didn't need pep talk" (1)
"Concrete examples of Food Webs" (1)

5. Most Outstanding Part of Workshop

"Lesson Plans"
"Made me feel good about what I was doing"
"Description of summer program"
"Slides"
"Organization of the presentation"
"Illustrative units and materials"
"Interest of presenters in the subject"
"Suggestions on classroom format"(2)

6. Suggestions for Improvement

"Geared for those who haven't worked with the impaired"(2)

Average attendance at each session was 20. Each of the school systems who sent students to the program or who hosted the presentations to science teachers also received copies of the final report.

Appendix I

Touch of Nature

Handicapped Program

Touch of Nature Environmental Center

Division of Continuing Education
Southern Illinois University
at Carbondale

SIU

Handicapped Program

Introduction

The Environmental Center's national renown began in the early 1950's when it first launched programs for handicapped children and adults. From an average of 200-300 campers a summer, it is now serving approximately 500. These programs for the physically, emotionally and mentally impaired are designed to enrich the lives of each participant.

Purpose

It is a direct goal of the summer handicapped program to enhance personal skill development and confidence building. The cornerstone of the program is the challenge available to participants to become more aware of themselves, of their potential and of their environment.

Throughout each session, emphasis is placed on forging those most important links of life—self-reliance, creativity, and a deep appreciation for the gifts of life. The program seeks to instill excitement in exploring the unknown, in learning new outdoor skills, making new friends and planning future goals.

Activities

Campers receive their carefully balanced meals in Freeburg Lodge and share their experiences in small groups housed in sturdy cabins nearby.

There are a range of camp activities available to them, including swimming in Little Grassy Lake, canoeing, rappelling, softball, and other sports. Skits, dramatics, and arts and crafts are also part of their day. They are introduced to gardening, plant and animal identification, and animal observation, helping to make each individual aware of the inimitable beauty of nature and of our responsibility to preserve it.

Staff

Supervisory and teaching personnel are chosen for their conscientiousness, maturity, and ability to relate with and assist handicapped individuals in an outdoor setting. There is a ratio of one counselor for each four campers throughout the sessions.

A resident nurse is on call twenty-four hours a day. Recreational specialists provide activities designed to the abilities of each group.

Participation

While many of the participants in the Touch of Nature summer camping program are sponsored by organizations for the physically or mentally impaired, most of the camp sessions are open to individuals under private sponsorship (scholarships are also available).

For further information about each of the sessions which are generally two weeks in length and held between June 1 and August 10, contact:

Camp Director
Touch of Nature
Environmental Center
Southern Illinois University
at Carbondale
Carbondale, Illinois 62901
(618) 529-4161

Appendix II

FOR IMMEDIATE RELEASE

CARBONDALE, IL   April 20, 1982--The deadline for application in the Free Summer Institute in Environmental Sciences for Handicapped High School Students has been extended to May 15. It was announced after a recent meeting between a representative form Southern Illinois University at Carbondale and Louisville area officials.

Dr. Mary Jane Sullivan informed Betty Womack of the Kentucky School for the Blind that physically handicapped youngsters from the Louisville region had three more weeks to apply for the educational program. Each of the two-week sessions June 7-18 and June 21 to July 2 are supported through a grant from the National Science Foundation.

Area youngsters will have the opportunity to absorb science instruction in a beautiful outdoor setting. The program will be conducted at Touch of Nature Environmental Center, 7 miles southeast of Carbondale, Illinois, a 3,000 acre nature preserve bordering Little Grassy Lake in the Shawnee National Forest.

Round-the-clock tutors and aides will assist the youngsters in a range of activities which include science experiments, boating, fishing and picnicking. The program includes a trip to La Rue Swamp, as well as an opportunity to work in the University's zoology lab one morning. Staff for each session include a registered nurse and a sign interpreter.

Bruce Petersen, zoology instructor, emphasized "We have taken into account the full range of handicapping conditions when planning our program. Youngsters who ordinarily wouldn't have had the chance to participate in a regular science lab in their high school will now be able to have a lot of fun while learning something new."

For application forms and additional information about the program local youngsters are urged to contact Betty Womack at (502) 897-1583 or Mary Jane Sullivan at (618) 536-7751.

SIU

Southern Illinois
University at Carbondale
Carbondale, Illinois 62901

Division of Continuing Education
618-536-7751

December 2, 1981

Director
United Cerebral Palsy Association
66 East 34th Street
New York, N.Y. 10016

Dear Director:

With support from the National Science Foundation, Southern Illinois University at Carbondale will offer physically handicapped high school students an opportunity to participate in a biological science outdoor laboratory workshop this summer.

The grant will cover room and board and instruction for a two week period for forty-eight students. The grant does not cover transportation to and from Carbondale, Illinois. As a consequence, this may restrict participation to students within a short geographical distance of Illinois. However, I am writing to you to acquaint you with this opportunity and hope you will pass on this information to your regional directors. I enclose ten brochures describing this program in detail.

Thank you for your assistance in spreading the word.

Sincerely,

Mary Jane Sullivan, Ed.D.
Project Co-Director

MJS:ssb

Enclosures

Appendix III

Schedule for NSF Summer Institute

TIME	TOPIC	APPROACH	INSTRUCTOR	SITE	SPECIAL ADAPTATION FOR MULTI-HANDICAPS
June 7 8-9 AM	*Pre-test	Written and Oral	Bruce	Indian Bldg.	
9-10 AM	Flow of Energy Lecture	Lecture with overhead illustrations	Bruce	Indian Bldg.	
10-11 AM	"Food Web" 'Who Eats Whom"	Outdoor games	Jim Jordan	Outside Indian Bldg.	
11-12	lunch			Freeburg Hall	
12:30-2:30	Aquatic Food Chains	Examination of lake specimens-plankton net	Jerry & Bruce	Lakeside	
2:30-6:45	Recreation, Dinner, Rest	Camp II	Sync,w. Butch		
6:45-9 PM	Recognition of flowers	Nature walk & pressed specimens	Butch	Camp II nature trails	
June 8 8-9:30 AM	Material Cycle	Lecture	Bruce	Indian Bldg.	
9:45-11 AM	Rotting Log	Examination of specimens	Bruce	Outside Indian Bldg.	
11-12:30	Lunch			Freeburg	
12:30-2:30	Collection of water and aquatic specimens	Ecman dredge pontoon boat	Bruce & Jerry	Lakeside	
2:30-6:45	R&R		Sync. w. Butch		

TIME	TOPIC	APPROACH	INSTRUCTOR	SITE	SPECIAL ADAPTATIONS FOR MULTI-HANDICAPS
6:45-8 PM	Microscopic examination of water samples	Hands on	Bruce	Indian Bldg.	Lap boards & magnifiers
8-9 PM		Film	Bruce	Main Room, Morris Lodge	Written outline of sequences
June 9 8-9:30 AM	Lake Ecosystem	Lecture & manipulable diagrams	Bruce	Indian Bldg.	
9:45-11:45	Fish Management	Game fish of 2 ponds	Jerry & Bruce	Oikas Area	
12-1	Lunch	Picnic		Oikas Area	
1-2:30 PM		Lecture	Paul Yambert	Indian Bldg.	
2:30-6:30	R & R and Dinner	Craft (bluebird boxes)	Sync. w. Butch	Indian Bldg.	Pre-cut parts
6:45-8 PM	Identification of Trees Speciation Keys	Nature walk	Butch & Bruce	Trails near Camp II	
Early Turn-in					
June 10 8 AM-5 PM	ALL DAY TO LA RUE SWAMP (Boxed lunch on site)	Field Trip	Bruce	La Rue/Pine Hills	
6-7 PM	Dinner			Freeburg	
7-8 PM	Limiting Factors	Lecture	Bruce	Main Hall, Morris Lodge	

TIME	TOPIC	APPROACH	INSTRUCTOR	SITE	SPECIAL ADAPTATIONS FOR MULTI-HANDICAPS
June 11 8-9 AM	Populations	Lecture	Bruce	Indian Bldg.	
9:45-11 AM	Sampling Techniques	Garbanzo Bugs	Laurie & Bruce	Outside Indian Bldg.	
11-12	Lunch			Freeburg	
12:30-4 PM	Capture/recapture Exercise	Tics	Bruce	Outside Indian Bldg.	
4-6:30 PM	R & R and Dinner		Sync. w. Butch		
6:45-8 PM	Examination of Bird Species	Records of Bird Songs			
8-9 PM	Craft	Bluebird boxes			
June 12 8-9 AM	Bird Homes/ Animal Homes	Games	Bruce	Indian Bldg.	
9-19 AM	Summary of Concepts Covered During the Week	Lecture & Question/ answer period	Bruce	Indian Bldg.	
10-11:30	Say Goodbye	Film	Bruce	Indian Bldg.	Written outline of sequences
11:45-1 PM	Lunch			Freeburg	
1:15-5 PM	Rapelling/modified teams course		Butch		
5:15-8 PM	Buffalo Tro	Campfire & Songs Barbecue Picnic			

	TIME	TOPIC	APPROACH	INSTRUCTOR	SITE	SPECIAL ADAPTATIONS FOR MULTI-HANDICAPS
June 13	9 AM	Breakfast				
	10-11 AM	Optional Outdoor Religious Service			Chapel Site	
	11-5	Shopping and Movie			Carbondale Mall	
	5:15-8 PM	Dinner & R & R				
June 14	8-9:30 AM	Forest Ecosystem	Lecture	Bruce	Indian Bldg.	
	9:45-11 AM	Plant Communities Oak/Hickory Forest	Outdoor Exploration	Jerry & Bruce	Secondary Succession Trail	
	11-12 AM	Sack Lunch			On the Trail	
	12:30-2 PM	Quadrat Study	Outdoor Exploration	Jim Jordan	Old field	
	2-6:45 PM	R & R and Dinner		Sync. w. Butch	Old field	
	6:45-8 PM	'Mzima - Portrait of A Spring"	Film	Bruce	Main Hall, Morris Lodge	Written outline of sequences
	8-9 PM	Review session	Vocabulary Quiz	Bruce	Main Hall, Morris Lodge	
June 15	8-12:30 AM	Methane Reaction		Bruce & LeFebvre	Zoology Lab Life Sciences	
	1-2:30 PM	Lunch			Freeburg	
	2:30-4 PM	Review of Lab	Questions & Answers	Bruce	Main Hall, Morris Lodge	
	4:15-8 PM	R & R, Dinner, R & R				

TIME	TOPIC	APPROACH	INSTRUCTOR	SITE	SPECIAL ADAPTATIONS FOR MULTI-HANDICAPS
June 16 8-9:30 AM	Interactions and Interdependence	Lecture	Bruce	Indian Bldg.	
9:45-11 AM	Parasitism, Predation	Outdoor Activity	Bruce		
11-12:30	Lunch			Freeburg	
12:30-2 PM	Relations Between Populations	Outdoor Activity	Bruce		
2-6:45 PM	R & R and Dinner		Sync. w. Butch		
6:45-8 PM	Complete Bluebird Boxes		Bruce	Indian Bldg.	
8-9 PM	Predator Calls	Owl Records	Bruce		Other exercise for deaf students
June 17 8-9:30 AM	Man and the Natural Ecosystem	Lecture	Bruce	Indian Bldg.	
9-11 AM	Site Development	Plant autumn olive, pine; set out bird boxes	Bruce & Jerry	Selected location	
11-12	Lunch	Sack lunch		On above site	
12-4:30 PM	Continued Site Development	Brush Piles Seed Packets	Bruce & Jerry		
June 18 8-9 AM	Pack		Bruce		
9:15-10 AM	Post Test		Bruce	Main Hall, Morris Lodge	

TIME	TOPIC	APPROACH	INSTRUCTOR	SITE	SPECIAL ADAPTATIONS FOR MULTI-HANDICAPS
10:30-12:30	Beneficial and Detrimental Modification of Environment by Man--An Examination of Carbondale From An Ecological Perspective			Vans	
12:30-2 PM	Lunch			Campus Lake	
2-5 PM	Travel Home				

INSTITUTE IN ENVIRONMENTAL SCIENCE
FOR THE HANDICAPPED, 1982
PRE TEST AND POST TEST

Name ____________________________

Date ____________________________

DIRECTIONS: Read each item carefully and select the one best answer for each multiple choice question. Circle the letter of the answer of your choice. For all items other than multiple choice, do exactly what the question asks you to do (i.e., list design, draw, etc.).

1. The amount of energy stored in organic material.

    a. Biomass
    b. Carrying capacity
    c. Diatom
    d. Foliage

2. The ability of the environment to support a population in optimum condition.

    a. Ecology
    b. Technology
    c. Wildlife management
    d. Carrying capacity

3. Any condition which inhibits growth.

    a. Succession
    b. Controlling factors
    c. Competition
    d. Limiting factors

4. The change of plant species through time starting with lichens on bare rock through a climax forest.

    a. Food chain
    b. Food web
    c. Competition
    d. Biotic succession

5. Rivalry between two different species for the same essential life requirements.

    a. Interspecific competition
    b. Food chain
    c. Niche
    d. Intraspecific competition

6. Rivalry between two organisms of the same species.

   a. Interspecific competition
   b. Food chain
   c. Plankton
   d. Intraspecific competition

7. A series of organisms, each depending upon the preceding for its food source.

   a. Succession
   b. Food chain
   c. Niche
   d. Growth factor

8. Almost all food chains begin with producer because ...

   a. only producers carry on photosynthesis.
   b. only producers can decompose the materials they use.
   c. producers are more numerous than consumers.
   d. producers grow and multiply faster than consumers.

9. Which statement best defines the term "consumers"?

   a. a green plant which manufacturers its own food.
   b. an animal that eats plants only.
   c. an animal that eats other animals only.
   d. an animal which eats plants or other animals.

10. Which statement best describes the term "habitat"?

   a. the abiotic elements in an organism's environment.
   b. the biotic elements in an organism's environment.
   c. the place where an organism lives.
   d. any functional region in the biosphere.

11. Which statement best defines the term "Niche"?

   a. the place where an organism lives.
   b. the role of an organism in the community.
   c. any relationship between an organism and an abiotic element.
   d. both biotic and abiotic elements in a community.

12. Within the biotic community represented by the pond, the plants and animals

   a. are always permanent residents of the pond community.
   b. are interrelated but do not interact with each other.
   c. are interrelated and do interact with each other.
   d. can survive by themselves even though they are interrelated.

13. Which statement best explains the general concept of "community"?

    a. the community included all producers and parasites.
    b. the community contains all consumers and decomposers.
    c. the community includes all living organisms.
    d. the community contains all living organisms and all abiotic variables.

14. The relationship in which one animal directly attacks another and is nutritionally dependent on it is ...

    a. mutualism
    b. parasitism
    c. predation
    d. both b & c

15. Eutrophication is a process which occurs in

    a. the atmosphere
    b. soils
    c. lakes
    d. plants

16. All mushrooms

    a. make their own food
    b. are decomposers
    c. are poisonous
    d. have no value in a food chain

17. All organisms have mechanisms to cope with environmental problems and to enhance survival of the species. They are considered to be

    a. adaptations
    b. defense structures
    c. social customs
    d. genes

18. The food chain that is in proper sequence is

    a. bluegill, algae, bass, hawk
    b. corn, mouse, raccoon, deer
    c. grass, cricket, frog, snake
    d. clover, mushroom, rabbit, eagle

19. The greatest number of organisms which one area can support in good health indefinitely is the

    a. carrying capacity
    b. critical zone
    c. saturation point
    d. ecological level

20. Man's influence on the ecosystem should be considered as

    a. totally destructive, with no improvements at all
    b. nonexistent -- things go on without any effect from man
    c. both good and bad, with need for present and future limitations
    d. completely positive, as is obvious by the comforts of life

21. The native hardwoods that account for the largest volume of Illinois forest products are

    a. black walnut and red cedar
    b. yellow pine and white pine
    c. white oak and red oak
    d. red maple and green ash

22. Good wildlife habitat

    a. is necessary for providing food, water, shelter and protection from predators
    b. is plentiful in Illinois and should not be of great concern
    c. is provided by unreclaimed strip mine areas after a few years
    d. results only from natural processes and cannot be produced by man

23. The major cause of the reduction of wildlife is:

    a. Automobiles
    b. Pesticides
    c. Hunting
    d. Habitat destruction

24. An example of sustained yield management is:

    a. Planting corn in the same field every year
    b. Selectively cutting only mature trees
    c. Removing all the peat from a swampy area

25. Farmers utilize fertilizers to:

    a. supplement nutrients removed when the crops are harvested.
    b. decrease the weed growth in their cultivated fields.
    c. improve the taste of the crop.
    d. create purification of adjacent streams and rivers.

26. Biodegradable refers to a substance that:

    a. will spoil if it is not properly refrigerated
    b. is made in a laboratory and appears life-like
    c. is long-lasting and has no known natural means of deterioration
    d. will break down on its own or through the action of organisms

Circle T if the statement is true, F if false:

27. T F The energy in a food chain can best be utilized by reducing the number of links in the chain.

28. T F The clearing of natural vegetation for the purpose of urban growth has beneficial effects for the watershed.

29. T F Technology expands man's niche.

30. T F Ecological or biotic succession in the forest may be paralleled to life in the cities.

Appendix V

NSF SUMMER INSTITUTE IN ENVIRONMENTAL SCIENCE

STAFF EVALUATION FORM

Touch of Nature, Summer 1982

We would like you to share some of your thoughts and suggestions on your experience in thos program Please answer the items below, add your comments and leave them with us. Your evaluations are very valuable for us and will be included in our final report to the National Science Foundation.

Please evaluate the following items using the scale: 1 is POOR and 5 is EXCELLENT. Should there be an item in which you did not participate, please mark that item DNP.

		POOR				EXCELLENT
1.	Accommodations	1	2	3	4	5
2.	Meals	1	2	3	4	5
3.	Staff rapport	1	2	3	4	5
4.	Staff/student rapport	1	2	3	4	5
5.	Staff training	1	2	3	4	5
6.	Staff competence	1	2	3	4	5
7.	How would you rate the overall scheduling of activities?	1	2	3	4	5
8.	Academic effectiveness of films	1	2	3	4	5
9.	Academic effectiveness of lectures	1	2	3	4	5
10.	Academic effectiveness of field experiences	1	2	3	4	5
11.	Programming suitability for special populations	1	2	3	4	5
12.	Appropriateness of recreational activities for special groups	1	2	3	4	5

13. Growth of self in:

Ability to work with range of handicapping conditions

1 2 3 4 5

Ability to accept people as they are

1 2 3 4 5

Ability to accept responsibility

1 2 3 4 5

Understanding of ecological principles and their application to daily living

1 2 3 4 5

Ability to maintain effective levels of activity for long periods of time in close quarters

1 2 3 4 5

General physical condition

1 2 3 4 5

14. Compare students as a group in Session One to students in Session Two according to scale H = High, M = Medium, L = Low:

Session I
Social interaction H M L

Academic interest H M L

Physical demands upon staff H M L

Concentration span H M L

Session II
Social interaction H M L

Academic interest H M L

Physical demands upon staff H M L

Concentration span H M L

15. Compare hearing-impaired students, visually impaired students, students in wheelchairs, students on crutches and others according to the scale of H for High, M for Medium and L for Low:

	Crutches	Wheelchair	Hearing Impaired	Vision Impaired	Others
A. Session I					
Social interaction					
Academic interest					
Demands on staff					
Concentration span					
B. Session II					
Social interaction					
Academic interest					
Demands on staff					
Concentration span					

16. Effectiveness of program in achieving objectives:

A. To introduce handicapped high school students to ecological concepts

1 2 3 4 5

B. To give handicapped students an opportunity to apply these concepts in an outdoor laboratory experience

1 2 3 4 5

C. To develop self-confidence in areas of experiential science

1 2 3 4 5

D. To develop students' sensitivity to societal impacts and value issues related to environmental planning

1 2 3 4 5

E. To serve as a model for school systems in methods of adapting science curriculum to the special needs of the handicapped

1 2 3 4 5

17. Growth of students as a group:

A. In self-confidence

1 2 3 4 5

B. In social adaptability

1 2 3 4 5

C. In concern for others

1 2 3 4 5

18. Effectiveness of specific program activities:

A.	Site improvement	1	2	3	4	5
B.	Bluebird box construction	1	2	3	4	5
C.	Succession trail	1	2	3	4	5
D.	Pollution control center	1	2	3	4	5
E.	Aquatic food chain	1	2	3	4	5
F.	Fish management	1	2	3	4	5
G.	La Rue Swamp	1	2	3	4	5
H.	Rotting log	1	2	3	4	5
I.	Lake ecosystem	1	2	3	4	5
J.	Tree identification	1	2	3	4	5
K.	Lima bugs	1	2	3	4	5
L.	Taxidermy demonstration	1	2	3	4	5
M.	Nature walks	1	2	3	4	5
N.	Guberatus	1	2	3	4	5

19. Other comments--please be as specific as possible in identifying program strengths and weaknesses:

Appendix VI

A. SELECTED STANDARD TEXTBOOKS

The following biology texts for high school students have chapters devoted to the major topics taught during the NSF Summer Institute in Environmental Sciences:

1.) Paul B. Weisz and Richard N. Keigh, The Science of Biology, McGraw-Hill. Chap. 8-9.

2.) Stanley Weinberg and Abraham Kalish, Biology: An Inquiry Into the Nature of Life. Allyn & Bacon, Inc. Chap. 27.

3.) An Ecological Approach, Biological Science: Houghton Mifflin Chapters: 1-2-3.

4.) Otto, Modern Biology, Holt Rinehart, Winston, Chap. 48-49-50-51.

The activities outlined & attached would be appropriate demonstrations of selected ecological concepts taught in these chapters.

B. Adaptations to Aspects of Science Classroom Management According to the Nature of the Handicapping Condition

NATURE OF HANDICAP	VISION IMPAIRED	HEARING IMPAIRED	ORTHOPEDIC IMPAIRED
Laboratory:	1) Label All equipment and supplies 2) Provide Audial Signals where possible 3) Project slides on wall where possible	1) Provide Visual clues/ 1) Advance written description	1) Pair with partner 2) Prepare lab station before class 3) Utilize lap boards for experiments where safe
Lecture:	1) Encourage taping of all classes 2) Carbon good note takers	1) Provide posters of all vacabulary and new terms 2) Illustrate all concepts in most concrete terms possible 3) Place student in center of the horseshoe to hear/see questions and answers 4) Repeat student's questions before answering 5) Utilize overheads rather than chalkboard	No adaptations
Testing:	1) Tape essay tests	1) Check reading level of all questions	1) Provide objective test for those with little coordination of Hands-extr time
Textbooks:	1) Provide Braille or large print format	No Adaptation Necessary	No adaptation Necessary

With all students encourage participation in discussion through examples of concepts which are relavant to their lives.

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C. ENERGY FLOW IN THE LAKE ECOSYSTEM

RATIONALE

Students are acquainted with terrestrial grazer food chains but have little understanding of aquatic ones. Since, three quarters of the earth's surface is water and since midwestern students don't have access to the ocean, students should also be acquainted with aquatic ecosystems.

Collection and identifications of lake food chain components can be an exciting and educational experience. Students will gain practice in using a variety of kinds of equipment: dip net, plankton net, seine microscope, keys. They will see organisms they have probably never seen.

MATERIALS

Plankton net
seine
dipnet
baby food jars
compound microscope
dissecting microscope
small petri dishes
slides
coverslips
medicine dropper
Prescott, How to know the Algae
Elly and Hodgson - Keys to freshwater invertebrates
Fish key
boat
white enamel pan
quart jar
gallon jar
forcep

PREPARATION

O	B	D		
.	X	X	1.)	Plankton net, seine, dip net, jars, medicine dropper enamal pan and forceps are put into box.
X	X	X	2.)	Students are divided into teams of five or six persons.
	X	X	3.)	Transportation is arranged for each tear.
X	X	X	4.)	Tasks are assigned to each team
X	X	X		a. collecting plankton.
.	X	X		b. collecting with the dip nets.
.	X	X		c. collecting with the seine.

EXERCISE

O	B	D		
X	X	X	1.)	Pull plankton net behind boat to collect algae and zooplankton from any lake or pond.
.	.	X	2.)	Use dip-net to capture minnows, crayfish, aquatic insects, tadpoles, etc.
.	.	X	3.)	Use seine for larger, faster organisms.
X	.	X	4.)	Return to classroom and identify the organisms using keys and microscopes.
X	X	X	5.)	Construct a food web by determining, as best you can, who eats whom.

ADAPTATIONS FOR HANDICAPPED STUDENTS

Orthopedically Impaired

1.) Transportation to aquatic habitat is a potential problem, although it can be solved in many ways:
    a. parents may have a specially adapted van for transporting the student;
    b. student can be lifted into and out of car by a strong student and a wheelchair can be collapsed and stored in the car's trunk.
2.) Students can push wheelchair to lake shore.
3.) Handicapped students can be lifted into and out of boats.
4.) Handicapped students may be able to drag plankton net.
5.) They may be able to use dip net.
6.) They may be able to help remove specimens from dip net and seine and place them in collecting jars.
7.) See also, suggestions in Decomposer Food Web exercise.

Blind/Vision Impaired

1.) If they can see, even a little, they can do all of the preparatory steps and all of the steps in the exercise itself.
2.) See suggestions in Decomposer Food Web exercise.

Deaf/Hearing Impaired

1.) If they understand the tasks, deaf students can do this entire exercise.

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D. THE FOOD CHAIN

Grass - grasshopper - frog - bass - man is readily understood by students, but only a small portion of the energy flowing through ecosystem goes that way. Most of it moves through the decomposer food chain.

Plants	small hervivores	small carnivous	bacteria and fungi
	earthworms, snails slugs, nematodes	spiders, small insects, mites	microbial grazers (colembola, mites)

Some of the very small organisms that form the intermediate links of the decomposer chain can be collected using simple materials and observed under the microscope. In addition to learning ecology, students will get practice in using microscopes and keys.

MATERIALS

(needed to collect and study
soil micron thropods)

Baby food jars

acetate

scotch tape

ring stands

5cm x 5cm pipe

cardboard with 10cm x 10 cm square hole

ziplock plastic bags

magic markers

isopropyl alcohol

glycerine

graduated cylinder

small petri dishes

dissecting microscope

Jaques Key, How to Know the Insects

Dindal, D.L., Suborders of Acarina, School of Forestry (S.U.N.Y.)
Syracruse, N.Y.

pencil

paper

hammer

hardware cloth

25 watt lamp

medicine dropper

Preparation

O	B	C		
.	X	X	1.	Make preservatives from 75% isopropyl alcohol, 20% water and 5% glycerine.
.	X	X	2.	Make a cone-shaped funnel using acetate sheet and scotch tape.
.	X	X	3.	Cut disc of hardware cloth to fit in the bottom of the funnel.
.	X	X	4.	Put funnel in ringstand, baby food jar beneath it and lamp above it (see diagram).
.	X	X	5.	Cut 10cm and 10cm square hole in piece of cardboard.
.	X	X	6.	Put cardboard square, pipe, hammer, plastic bags, magic markers in box.

Exercise

O	B	D		
X	X	X	1.	Go with class to prairie, woods, schoolyard, camppost heap, other collecting sites.
X	X	X	2.	Toss carboard square to ground.
X	X	X	3.	Collect all leaf litter and other loose detritus in thin square and place litter in plastic bag. Label bag.
.	X	X	4.	Push pipe into the soil in the center of the cardboard square, (use hammer if necessary) and collect soil sample within pipe. Place in plastic bag and label.

Exercise (cont)

O	B	D		
.	.	X	5.	Place sample on hardware cloth disc in funnel.
.	X	X	6.	Put baby food jar of perservative under funnel.
X	X	X	7.	Twenty-four hours after sample has been placed in funnel over collecting jar, light the lamp above the funnel and let it burn constantly for ten days.
.	.	X	8.	Carefully pour entire contents of collecting jar into small petri dish. Remove any remaining solid matter with medicine dropper.
.	.	X	9.	Identify mites and collembola collected using Dindal's key,,and Jaques' key.

Orthopedically Impaired

1.) Student notetaker using NER paper.

2.) Provide written directions for students the day before exercises begin.

3.) Wheelchair can be taken on collecting trip with students helping to push it.

4.) Student may be able to throw cardboard to determine sample site.

5.) Student may be able to leave chair to gather litter sample.

6.) Microscope can be made easier to use be devising layer knobs for it.

7.) Laboratory table must have enough clearance for chair.

Orthopedically Impaired (cont)

8.) Microscope may be easier to use from a lap board.

9.) Those with manual dexterity can help assemble collecting apparatus.

10.) Large felt-tipped magic markers for writing.

Blind/Vision Impaired

1.) Student notetaker using NCR paper.

2.) Provide taped directions in large type for students the day before exercises begins.

3.) Tape records instructions and discussion.

4.) Overhead projector

5.) Braille labels on bottles.

6.) Microprojector to view specimens.

7.) Sighted students can make models of specimens.

8.) Blind can gather soil samples, mix reagents and assemble apparatus.

9.) Sighted student should provide elbow to guide blind student on collecting trip, if needed.

Deaf/Hearing Impaired Students.

1.) Provide written directions for students the day before exercises begin.

2.) Provide student notetaker and NCR paper

3.) Use interpreter if possible.

4.) Speak slowly and look directly at the student when speaking.

Deaf/Hearing Impaired Students (cont)

5.) Make ample use of the overhead projector.

6.) The deaf student should be encouraged to participate in activity in all parts of the exercies.

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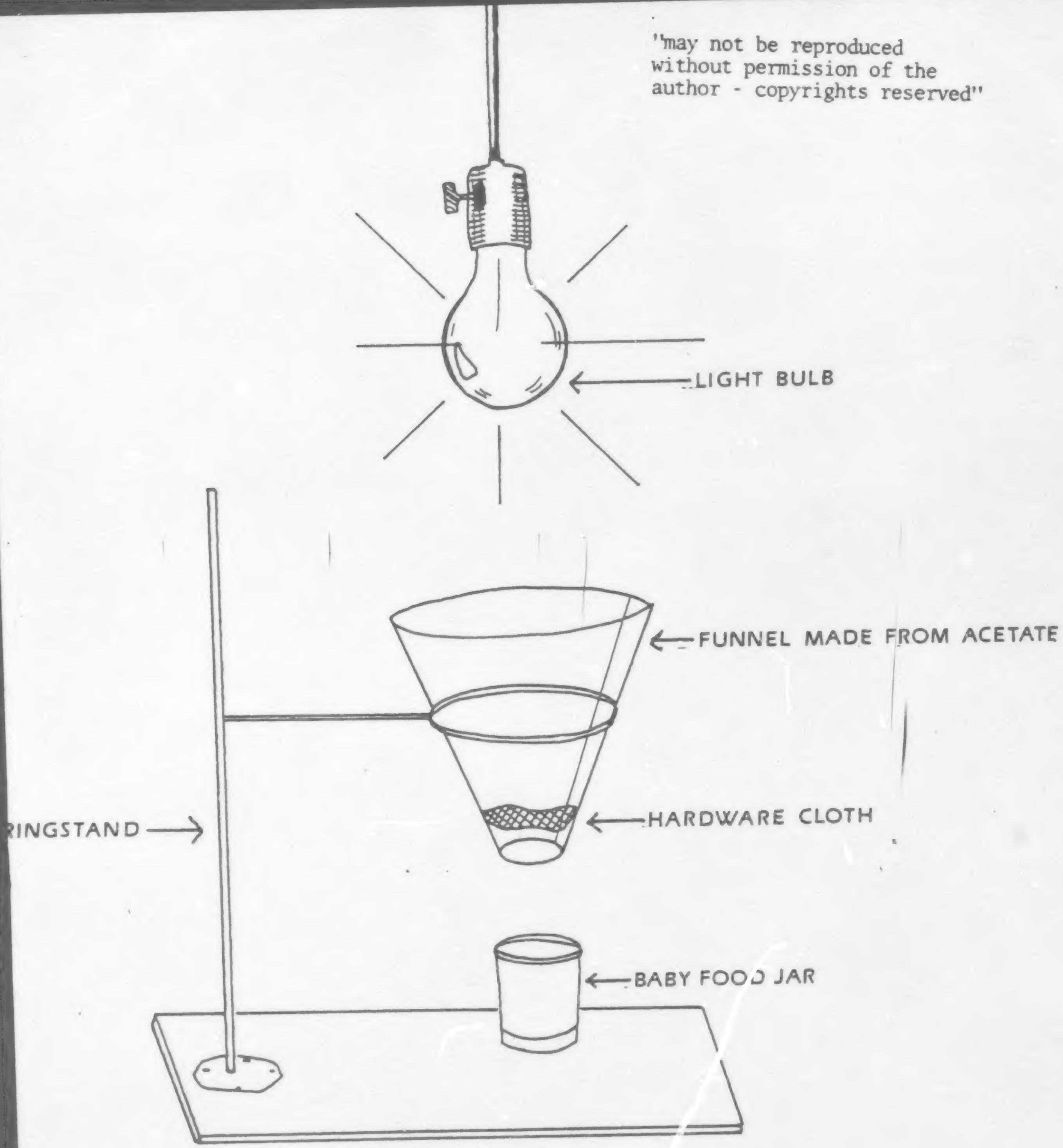
LIGHT BULB
FUNNEL MADE FROM ACETATE
HARDWARE CLOTH
RINGSTAND
BABY FOOD JAR

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MATERIALS FOR THE HANDICAPPED

Braille Technical Tables Bank
National Braille Association
c/o Mrs. James O. Keene
31610 Evergreen Road
Birmingham, Michigan 48009

Chadwick Miller, Incorporated
Canton, Maine 02021

Edmund Scientific Company
300 Edscarp Building
Barrington, N.J. 08007

National Technical Institute for the Deaf
Rochester Institute of Technology
One Lomb Memorial Drive
Rochester, N.Y. 14623

Note Taker - special tablet.
It is usable for those
with impaired upper extremeties
as it is for the deaf.

Science for the Blind Products
Box 385
Wayne, Pennsylvania 19087

Science for the Handicapped Association
c/o Ben Thompson, SSS 200
University of Wisconsin at Eau Claire
Eau Claire, Wisconsin 54701

SEIMC
New York State Education Department
55 Elk Street
Albany, N.Y. 12234

Pamphlet - "Teaching Aides
for Children with Cerebral
Palsy."

CATALOGS ** For equipment, instructional tools, etc. order these catalogs:

American Foundation for the Blind, Inc. (AFB)
15 West 16th Street
New York, New York 10011

SFB Products (Science for the Blind)
Box 385
Wayne, PA 19087
(215) 687-3731

Thermoform 55 and Brailon (For making plastic copies of raised diagrams)
American Thermoform Corporation, R.H. Dasteel, President
8640 East Slauson Avenue
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Recording for the Blind - taped texts, if marked with RLD means tapes are
215 East 58th Street accompanied by tactile diagrams.
New York, NY 10022 (send $5 in advance for catalog)

American Printing House for the Blind
1839 Frankfort Avenue
P.O. Box 6085
Louisville, KY 40206

Tele-Sensory Systems, Inc. (talking calculator, paperless brailler, etc.)
3408 Hillview Avenue
Palo Alto, CA 94304

Howe Press of Perkins (Perkin's Brailler)
School for the Blind
Waterton, MA 02172

Braille Book Bank (list of brailled books)
National Braille Association
85 Godwin Avenue
Midland Park, NJ 07432

National Library Service (where to order taped materials in your state)
The Library of Congress
Washington, D.C. 20542

Visual-tek (closed circuit T.V. magnifier)
Department JVIB, 1610 26th Street
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RESOURCES (continued)

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MOVIES**

"What Do You Do When You Meet A Blind Person?"
20 minutes, educational comedy, AFB (American Foundation for the Blind)

"Not Without Sight"
20 minutes, a behind the lens look at visual impairments, AFB

"A Different Approach"
22 minutes, educational comedy about interacting with handicapped person, CENTS, Renae Hausmann (612) 330-1140, $25

Minnesota State Services for the Blind and Visually Handicapped film about typical U.S. State Services offered to clients, contact
Minnesota State Services, 1745 University Avenue, St. Paul, MN 55104

SLIDES**"Biology for the Blind", $25, D. Tombaugh, 971 Richmond Road,
Lyndhurst, OH 44124

RAISED LINE DIAGRAMS**

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Nancy Amick, Princeton Unit
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100 Sotckton Street
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Contact:
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31610 Evergreen Road
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Minimum order = $1 or .15 a page. Send a photocopy of your requested table.

BOOKS**

The Unseen Minority, A Social History of Blindness in the US,
Koestler, Frances A., David McKay Co., Inc. New York, 1976

Social and Rehabilitation Services for the Blind
Hardy, Richard E.,; Charles C. Thomas Publication, Springfield, IL, 1972

Resources

BOOKS (continued)

Biology for the Blind
Tombaugh, Dorothy, write to author, 971 Richmond Road, Lyndhurst, OH 44124, Send $4.00

White Coat, White Cane,
Hartman, Dr. David

Out of Sight,
Sperber, Al

Laboratory Science and Art for Blind, Deaf, and Emotionally Disturbed Children,
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To Race the Wind
Krents, Harold

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- International Guide to Aids and Appliances for Blind and Visually Impaired Persons, Port City Press, Baltimore, MD 21208
- Sensory Aids for Employment of Blind and Visually Impaired Persons: A Resource Guide

MAGAZINES AND BROCHURES**

"Journal of Visual Impairment and Blindness", AFB

"Education of the Visually Handicapped", AEVH-Ass. for Education of VH.
ISSN 0013-1458
919 Walnut Street
4th Floor
Philadelphia, PA 19107

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HEW, Washington, D.C. 20201

"Science for the Physically Handicapped in Higher Education - A Guide to Sources of Information"
Environmental Science Information Center
Library and Information Service, Division D822
6009 Executive Boulevard
Rockville, MD

MAGAZINES AND BROCHURES** (continued)

"A Resource Directory of Handicapped Scientists" and
"Science for Handicapped Students in Higher Education", $3 each
Project on Handicapped in Science
Office of Opportunities in Science, AAAS
1776 Massachusettes Avenue N.W.
Washington, D.C. 20036

"Programs for the Handicapped"
Office for Handicapped Individuals
338 D Hubert Humphrey Boulevard
200 Independence Avenue SW
Washington, D.C. 20201

"Sensory Aids Foundation Report" update pamphlets
399 Sherman Avenue
Suite 12
Palo Alto, California 94306
(415) 329-0430

Vendors

AEVH - Association for Education of Visually Handicapped
ISSN 0013-1458
919 Walnut Street
4th Floor
Philadelphia, PA 19107

AFB - American Foundation for the Blind, Inc.
15 West 16th Street
New York, New York 10011

Am. PHS - American Printing House for the Blind
1839 Frankfort Avenue
P.O. 6085
Louisville, Kentucky 40206

ATC - American Thermoform Corporation
8[illegible]40 East Slauson Avenue
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ANM - Atlantic Northeast Marketing, Inc.
P.O. 921
Marblehead, MA 01945

CBS - Carolina Biological Company
2700 Yorle Road
Burlington, NC 27215

EME - P.O. 17
Pelham, New York

Fisher - Fisher Scientific Company
711 Forbes Avenue
Pittsburgh, PA 15219

Griffin Manufacturing
1656 Ridge Road East
P.O. 308
Webster, New York 14580

Howe Press - of Perkins
School for the Blind
Waterton, MA 92172

Midwest Education (Visualtek Branch)
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Santa Monica, California 90404

MPL - Medical Plastics Lab, Inc.
P.O. 38
Gatesville, Texas 76528

MV - Magna Visual, Inc.
1200 North Rock Hill Road
St. Louis, MO 63124

Vendors (continued)

NTA - National Teaching Aids
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Garden City Park, New York 11040

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Rochester, New York 14620
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31610 Evergreen Road
Birmingham, Michigan 48009

PHIS - Project on Handicapped in Science
Office of Opportunities in Science, A.A.A.S.
1776 Massachusettes Avenue N.W,
Washington, D.C. 20036

RFB - Recording for the Blind
Princeton Unit, Nancy Amick
100 Stockton Street
Princeton, NJ 08540

SFB - Science for the Blind Products
Box 385
Wayne, PA 19087

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Books

Sensory Aids for Employment of Blind and Visually Impaired Persons: A Resource Guide	AFB
International Guide to Aids and Appliances for Blind and Visually Impaired Persons	AFB
Lab Science and Art for Blind, Deaf, and Emotionally Disturbed Children	Univ. Park Press
Accessibility Standards, Illustrated	Debbie Albert
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